

March 30, 1959

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AVIATION CALENDAR

(Continued from page 1)

May 27-Joined Eastern Regional Meeting Institute of Navigation, Friendship Inn, Belmont, Md.

May 28-24th Annual Regional Meeting Institute of Navigation, Friendship Inn, Bel Air Motor Hotel, St. Louis, Mo.

May 29-May 1-First National Metal Processing Conference, American Society of Mechanical Engineers, Hotel Sherman, New York City.

May 30-Join 12th Annual Institute of Navigation Meeting, National Society for Aviation Research, Institute of Technology, Cambridge, Mass.

May 31-Symposium on Electronic Components, 1959 Annual Meeting, IRE, Hotel Sherman, New York City.

June 1-3-1959 Annual Regional Meeting, Goodman Hotel, Stamford, Conn.

June 1-3-1959 Annual Regional Meeting, Hotel Sherman, New Haven, Conn.

June 4-National Astronomical Electronics Conference, Hotel Sherman, New Haven, Conn.

June 4-7-1959 Annual Flight Test Instrument Seminar, Symposium organized by the Instrument Society of America, Seattle, Olympic Hotel, Seattle, Wash.

June 5-1959 Annual Regional Meeting, Hotel Sherman, New Haven, Conn.

June 6-1959 Annual Regional Meeting, Hotel Sherman, New Haven, Conn.

June 7-1959 Electronic Components Conference, Brigitte, Stamford Hotel, Philadelphia.

June 9-11-1959 Annual National Conference on Space Electronics, Hotel Sherman, Stamford Park Hotel, Washington, D. C.

June 18-20-1959 Annual National Conference, South of Acoustical Weight Engineers, Hotel Sherman, Stamford, Conn.

June 22-23-1959 National Space Meeting, Hotel Sherman, Stamford, Conn.

June 23-25-1959 Annual Meeting, Hotel Sherman, Stamford, Conn.

June 23-26-Joint Int'l. Assoc. Conference, American Society of Civil Engineers, Hotel Sherman, Stamford, Conn.

June 23-26-1959 Glass, Paint, Lamination and Antivibration Exhibit and Symposium, Cincinnati Series, Institute Series, Society of Strength, Hotel Sherman, Cincinnati, Ohio.

June 24-Joint 14th International Astronomical Congress, Hotel Sherman, Stamford, Conn.

June 25-27-1959 Annual Meeting, American Society of Mechanical Engineers and Instrument Society of America.

June 25-28-Joint Int'l. Assoc. Conference, American Society of Civil Engineers, Hotel Sherman, Stamford, Conn.

June 28-30-1959 Glass, Paint, Lamination and Antivibration Exhibit and Symposium, Cincinnati Series, Institute Series, Society of Strength, Hotel Sherman, Cincinnati, Ohio.

June 28-30-1959 National Telecommunications Conference on Investigations of Space, Space Policy and Communications Policy, Hotel Sherman, Stamford, Conn.

June 29-30-1959 Glass, Paint, Lamination and Antivibration Exhibit and Symposium, Cincinnati Series, Institute Series, Society of Strength, Hotel Sherman, Cincinnati, Ohio.

June 30-Joint Int'l. Assoc. Conference, American Society of Civil Engineers and Instrument Society of America.

July 1-3-1959 Annual Meeting, Hotel Sherman, Stamford, Conn.

July 1-3-1959 Annual Meeting and Antivibration Exhibit, Stamford Rodder Hotel, Hotel City, San Diego, Calif.

July 21-27-1959 Broadcast International Convention, Hotel Sherman, Stamford, Conn.

Aug. 9-Symposium, 14th Annual Congress International Vibration Problems, Church House, Westminster, London, Eng.

Sept. 7-13-1959 Manufacturing Process Development and Evaluation, Society of Broadcast Constructors, Faubourg, Eng.



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Nashville's facilities include 261,000-square feet of "high bay" floor space. It has proven itself in advanced processing techniques, such as metal bonding, chemical etching, aluminum honeycomb structures for the aircraft of today, and aircraft stainless steel honeycomb structures for aircraft and models of the future.

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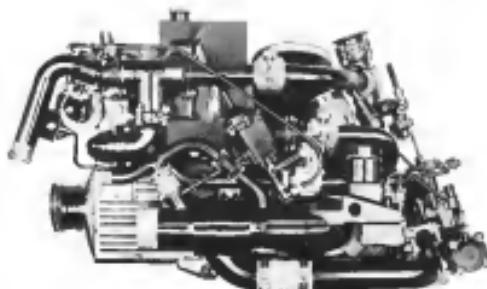
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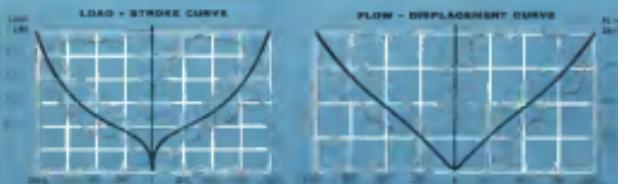


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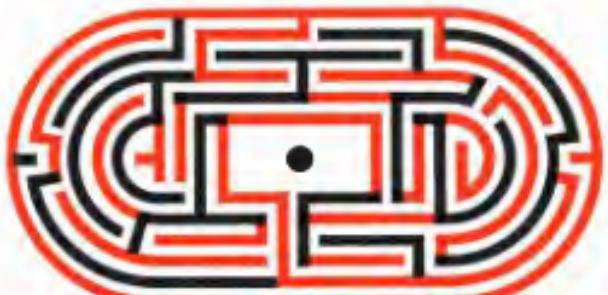
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(right) Navy Polaris AX-2 flight test vehicle at beginning of launch. Lockheed's Polaris fleet has delivered more than a year ahead of original schedule.

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An integral aspect of Lockheed's basic research and development is the systems approach to optimize flight performance by means of computer simulation of missile software, aerodynamics and guidance characteristics.

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EDITORIAL

Secrecy Fog Thickens

The recent exposure of *The New York Times* with the Defense Department and White House over publication of Project Argus is a typical example of how a deliberate effort is being made to thicken the fog of secrecy that separates the American people from the real policies and decisions of the government.

This fog of secrecy and attempted censorship is inherent in any government. But it has become particularly acute during the last three years in the tremendous impact of new techniques in the traditional methods of operating the government. There are two choices available to the men who attempt to update contemporary government. They can either get fresh article these galloping techniques and exploit them fully to provide the technical foundations for a burgeoning civilian and international scientific and military leadership, or they can try to stifle and ignore them until the inevitable proves these techniques generic. Four last, repressed policy shifts and their attendant attempts at justification by suppression or gobbling of the facts.

We can well understand the soul searching. The *New York Times* went through during its six-month investigative effort to get more solid facts on Project Argus into print and the final impasse with government packaging that resulted in its courageous decision to give the American people the facts about an event that was vital significant, not only for the future of this nation but for the survival of the human race on this planet. It is similar to the process that magazine went through 18 months ago when we made the decision to tell the American people the facts about Soviet missile developments and how they had been made known to our government through uninterpretable technical methods (*AW* Oct. 21, 1957, p. 26) but courageously ignored to make plausible a drastically reduced research and development budget.

In both cases, there was some element of genuine military secrecy involved. The basic decision the editor had to make was whether the other considerations involved in allowing the American people to proceed along an inherently dangerous policy in blind ignorance resulting from government imposed secrecy were more important than the relatively small element of military secrecy. Both *Aviation Week* and *The New York Times* made the same ultimate decision that informing the American people as a matter vital to their future was the most important consideration.

It is interesting to retrace to date that in the case of our stay on the U.S. missile monitoring system, of which the Telexlink radar installation at Stennis was only a part, the security was raised by some government officials prior to a hush-hush. The missile monitoring network has been operating continuously and effectively since *Aviation Week's* disclosure of its existence and is now operating as an augmented form more efficiently than ever before.

We expect a similar pattern to emerge from the alleged security considerations of Project Argus. It is difficult to understand a policy of attempted concealment of layers of nuclear radiation projected into space in a 100 mile thick layer and extending around the world. There

is evidence that their existence had long since been detected by foreign scientists.

During the past few months there have been numerous other examples of how the government policy of getting the American people just what it wishes them to know about their own affairs and future has been trapping and exposing some basically sound decisions and positions in its technical areas. Among them are:

- **Atomic Energy Commission** seems poised on radiological safety, including radioactive life off from nuclear tests. These are presently the result of the regime of Lewis Strauss as chairman of AEC, his successor, John McCone, has indicated basic changes in the AEC safety position set in prospect. It is clearly evident that as an independent agency it is required to keep a close and continuing check on radiations effects on nuclear testing.
- **National Space Council**: Recent hearings before Senate investigating committee have confirmed our earlier prediction (*AW* Oct. 6, 1958, p. 21) that the group which was delegated to Congress to be the space policy setting organization has been situated and bypassed by the White House, and the details of the committee's operation and position in space policy are still being clouded in official secrecy.

- **Nuclear Forward Aircraft**: The more the real official secrecy is being lifted by congressional and individual sources the less the solid fact and technical grounds appear to remain for the official policy of refusing to effectively support that vital technical program. As long as the official secrecy blanket was complete on this program, its technical feasibility could be stalled.

- **Advanced Research Projects Agency**: The tight jet launch secrecy imposed on the Project Score committee citizens initially enabled by government officials to pre-vey a completely like and unorganized evaluation of its technical achievements. This plasma space problem lasted only as long as the basic facts were concealed.

- **Renegotiation Board**: The secrecy in which this agency determines fiscal policy with relation to defense contraction without any regard to Defense Department policy or the policy of any other government agency concerned is certainly inconsistent with the rights of the American taxpayer to know the full facts on the financial transaction with which they are bearing their defense burdens and vital research for the future.

- **Defense Department**: The Office of the Secretary of Defense, in contrast to the three military services, is now operating as an information policy which has release of all and all information except that which is specifically classified at any specific time. It is the most blatant attempt at imposing totalitarian government censorship that this country has ever seen, and it is being pursued with the type of espionage, distortion and deliberate manipulation of news that we have never seen associated with foreign propaganda ministries.

It is the job of the American press, both general and technical, to cut through this thickening blanket of official fog and to do the job as best they can of getting the facts to the American people on how the galloping technology of our era will affect their future as individuals and as a nation.

—Robert H. Lee

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WHO'S WHERE

In the Front Office

Robert S. Gauthier, vice president and technical director, ITT Laboratories Norley S. 2, research division of International Telephone and Telegraph Corp.

George J. L. Lohr, a director, Pacific Standard Co., Los Angeles, Calif. Mr. Lohr is a president and issued charters

of Lohr Inc. Corp.

Robert T. Shatto, president, The Hydromatics Corp., Los Angeles, Calif.

William H. Abner, president, Research Communication Inc., 1000 Avenue of the Americas, New York, N. Y. 10019, established a new division and made the following appointments: **William A. Jones**, president, Mission Products Division; **Joseph M. Man**, Dr. **John W. Wilson**, Jr., president and **Frank A. Fink**, director, Space Division; **John W. Wilson**, Jr., president, Space Division, Los Angeles, Calif.

John W. Wilson, Jr., vice president and general manager, Transon Electronics Inc., Los Angeles, Calif.

James T. Drury, Jr., vice president research and development, Robert Armstrong Corp., White Plains, N. Y.

Capt. Paul J. Senn (SBN, 1st) was promoted to project and planning, Flight Support, Inc., Yonkers, N. Y.

John F. Potts, executive vice president and general manager-scholar agency, and **loyd F. Pease**, sales manager, Star and Data, Inc., Greenwich, Conn.

John F. Potts, executive vice president

and general manager-scholar agency, and **loyd F. Pease**, sales manager, Star and Data, Inc., Greenwich, Conn.

INDUSTRY OBSERVER

► Air Force's new air-launched ballistic missile, designated WS-115A, will employ inertial guidance. Three of the U.S. companies bidding in missile projects, including Boeing, Bell Aircraft, Thompson Ramo Wolden and Lockheed-Georgia, propose to use inertial systems developed by North American Aviation's Division. Northrop plans to include its own inertial system in its new Northrop Division. Fairey and Vought are soliciting development of inertial guidance. Douglas General Electric, Martin, McDonnell, North American, Rockwell, Republic and Vought propose to use Keenert inertial guidance.

► **Hughes Aircraft and Westinghouse Electric** will submit antiballistic missile defense feasibility studies with their own bids to Air Force, totaling a total of nine companies to submit such reports. Other seven companies received \$490,000 Air Force study contracts (AW Feb. 2, p. 21). They are Boeing, Convair, Lockheed, General Electric, General Mills, McDonnell Division, Radio Corp. of America and Martin.

► **Boeing** and **Grumman** will submit antiballistic missile defense feasibility studies with their own bids to Air Force, totaling a total of nine companies to submit such reports. The Hughes bid will be speeds up to 2000 mph but in a flat mission will be to explore outer space at 200,000 to 4,000 miles and, which is the most critical in the missile field, will be point-to-point. All three should resemble the *Interceptor*. **Convair** will bid in the upper stratosphere and is expected to have better landing characteristics than the North American X-15, its predecessor in research aircraft.

► **Cost of a Vanguard satellite vehicle plus the cost of firing is \$5.5 million per shot.** Total program cost is \$87 million. Thrust of third stage solid-boost Coandă rocket engine climbs from 2,600 lb at sea level to 3,100 lb at altitude.

► **General Electric Heat Test Reactor No. 3 (HTRE-3)** is scheduled to operate again within the next few months to complete its programmed experiments as part of GE's aircraft nuclear reactor project. Fuel cells of HTRE-3 were damaged late last year (AW Dec. 8, p. 21) by an accident attributed to errors made in electrical installations. New cells have been made.

► **U.S. 5 plane** a series of space planes to operate with greater economy by the Administration (last October from the earth to the moon). Accretion now is looking only to cover a portion of a broad market that includes a plane fixed toward Venus and able to orbit a planet eight times as far away as Earth, or 140,000 mi. Prototype will be funded under National Aerospace and Space Administration's space station program. Soviet lunar probe for Jan. 2 is believed to have been designed to imitate the Administration's Unit.

► **Approximately 17 military and space planes** and about 300 sounding rockets will be launched in calendar 1968 under present National Aerospace and Space Administration plans. Plan also call for 17 satellites and 40 sounding rockets in the current calendar year.

► **Combined satellite and space probe tracking network** for Defense Department-National Aerospace and Space Administration will include 25-ft dishes at the Goldstone, Calif., site of Woomera, Australia, and in South Africa, to be operated by NASA; an M-41 dish in Spain and a secondary high-capacity acquisition antenna in Japan, to be operated by Defense, and seven other tracking sites in the U.S. for military and space flight support. The tracking network will include five sites in Mississippi, one in Alaska, the U. S., Newfoundland and Canada and stations in Hawaii, Texas and Australia for tracking and control of the manned satellites.

► **Bell Helicopter's XV-1 Converiplane** contract has been extended by Air Force to provide for further flight testing. Extent will allow Bell to test out the XV-1's gear shift system which reduces takeoff speed about 50% at forward flight.

[Continued on page 185]

ABOARD
THE NAVY'S
A3J-1
VIGILANTE

**COLLINS
ELECTRONICS**

Striking at supersonic speeds in all weather, North America's A3J Vigilante Attack Bomber is a powerful and versatile weapon in the Navy's arsenal of weapons.

Aboard the Vigilante is the Collins-developed AN/AQD-191/AN/AL-1 Computerized Navigation and Guidance System, which is tailored to meet the stringent requirements of the A3J Weapons System. Shifting use of the modular design concept reduces the advantages of standardized production and carrier support.

Using to the fullest extent the unique Collins background and expertise in avionic design and system engineering, the AN/AL-1 system is thoroughly tested for performance, reliability, interference suppression and environmental compatibility. It provides the A3J Weapons System with outstanding electronic capability.



COLLINS RADIO COMPANY • CEDAR RAPIDS • DALLAS • BURBANK

Washington Roundup

Schriever to Head ARDC

Gen. Bernard A. Schriever has been picked to lead USAF's Air Research and Development Command after a long interlude within Air Force over the choice. Non-drug congressional ARDC. He has been head of the Defense Materiel Division since August, 1954. Schriever, whose new appointment was first reported by Aviation Week on May 16 (p. 35), will succeed Lt. Gen. Ernest A. Anderson, who formally left his post on May 10 to take over command of the Air Materiel Command.

New appointment for Schriever will carry with it a three-year term.

Space Council Appointments

In other appointments, Dr. John T. Rehfeldt, president of the Illinois Institute of Technology, has succeeded Lt. Gen. Donald R. Lovelace as a member of the aerospace and space council, governing body of the National Aeronautics and Space Council. Governing body of the National Aeronautics and Space Council. Dr. Rehfeldt brought from the post also letters of objection of the Board of Space Technology Laboratories to avoid any possible conflict of interest (AW, Jan. 18, p. 25). At the same time, the President nominated William A. M. Borden, a New York business executive to the council. Borden has been serving on the group by recent appointment.

In Congress

Meanwhile, Capitol Hill developments include:

- **Weapons system.** House Armed Services Subcommittee headed by Rep. Edward Robert (D-La.) will begin public hearings April 25 on management and weapons system type procurement. First witness will be Richardson. Subsequently, that day, will be congressional defense weapons committee.
- **Aviation.** House Appropriations Committee will be in the process of finalizing fiscal 1967 budget for action on the floor. At the surface, the Department of Defense's proposed bill and the independent office bill containing funds for Federal Aviation Agency, National Aeronautics and Space Administration, and the Civil Aeronautics Board will be reported out by the committee by May 1.
- **Regulations.** House Ways and Means Committee's bill is blocked out through April 21—indicating that extension of the congressional break will not be considered until after that date.

- **CAIB investigation.** House Legislative Oversight Sub-committee, headed by Rep. Otto Glass (D-Cal.) has not yet organized a staff. When this is completed, probably in a few weeks, the group will proceed to program reorganization of the activities of Civil Aeronautics Board and other regulatory agencies.

Airport Aid

House and Senate conference on airport and legislation will go into conference to reconcile the \$465 million voted by the Senate for a five-year period and the \$257 million voted by the House when Congress adjourned session on April 6 after an Easter recess.

The Senate program, despite Administration opposition, was passed 63 to 32 (AW Feb. 16, p. 39). The

House version was finally voted 271 to 174 after another attempt to reduce the \$257 million even further. The Administration, represented by Federal Aviation Agency Administrator Edward Gossard, had proposed a \$280 million program.

The two key Senate amendments defeated, or record votes provided:

- Reduction in the program to \$200 million. Offered by Rep. James Doolin (D-Ga.), the amendment was defeated 194 to 214, after having been previously approved on an unrecorded vote.
- Repeal yearly-per-project appropriations for federal and proposed by Rep. John Bell Williams (D-Mo.), the was defeated 157 to 216.

The House voting indicates that there is not enough strength in Congress to override a possible presidential veto of the airport legislation.

The President has vetoed a four-year \$675 million program.

There are the differences between the House and Senate versions of airport legislation:

- House bill provides \$65 million a year for allocation by the states and territories after a formula based upon area and population as compared with \$75 million in the Senate bill.

- House measure gives the Federal Aviation Agency Administrator a discretionary fund of \$70 million in fiscal 1966, \$65 million in fiscal 1967 and \$70 million in fiscal 1968. No funds for discretionary use are provided for fiscal 1969. Senate authorized \$25 million a year for the four years.

- Senate bill provides a \$65 million emergency fund foreterminate expenses. This provision was completely eliminated by the House.

Jet Fare Study

In another area, early groundwork to set distance jet fares for a new airline was with the Civil Aeronautics Board and the work regarding compensation rates was point within the two months. CAB pointed out at the time it granted jet authority to American Airlines that it "granted a background of at least one month or more jet experience upon which to base our study of jet fares." Estimates of several domestic passenger totals on July 31 will further serve to highlight the need for a CAB ruling on this matter. Board members say a decision in the General Passenger Fare Investigation is expected soon, but it is unlikely to provide any final answer to jet fares.

Supplemental Squeeze

Greater opportunity for the newly-enforced supplemental air fares to win contracts for international route traffic is still against scheduled airfares is being granted by A. J. Rose, vice president of Los Angeles Air Services, who said last week in a talk to the Small Business Committee of the National Association of Transportation. He added that, if as appears to be the Small Business Administration, "most expert in aviation, Small Business Administration units advise from the very military people who manage" the lists. He proposed the CABs go to the Federal Aviation Agency or the Civil Aeronautics Board for advice in cases of such appeals.

—Washington staff



PROJECT ARGUS test vehicle is employed on deck of U.S. Navy experimental missile ship, the USS *Nimitz*, bound, prior to flying test September. Night flying view at right. Vehicle was a modified USAF K-17 missile, manufactured by Lockheed Aircraft Corp.

Space Technology

Argus Radiation Hit 4,000 mi. Altitude

By Everett Clark

Washington—Electrons injected into the earth's magnetic field by three small high altitude nuclear explosions last August and September apparently were deflected as late as Dec. 6 and traveled out as far as 4,000 mi into space along magnetic lines of force. Strongest part of the initial radiation came at altitudes to that of the natural Van Allen radiation belts.

The 100-μ thick "shell" produced by the trapping of these electrons between magnetic lines was mapped and measured so thoroughly in the *Project Argus* (AW Mar. 25, p. 36) that the shape and intensity of the earth's magnetic field can now be predicted with "considerable accuracy out to distances of the order of several earth's radii," according to the President's Science Advisory Committee and the International Geophysical Year committee of the National Academy of Sciences.

Such data, and accurate predictions of the Argus experiments and its variants, mean that there will be considerable further exploitation by similar techniques.

Summary of the uncertain findings of Argus was released by the White House last week at a press conference apparently called as a result of strong criticism from the press and some scientists over

not being officially released before the time, it was considered advisable to withhold all results classified until a proper sorting of the information could be accomplished.

Results occurred in the early morning of Aug. 27 and Aug. 30, 1958, and shield bursts,indsight Greenwich time on Sept. 6 at a latitude of approximately 45 deg with mid-point between longitude 200 and longitude 180 deg west, at altitudes about 100 mi. Longitude was chosen to minimize the loss of electrons to the atmosphere.

Results of the traps, measured by satellite, rocket, aircraft, ground stations and ground equipment and one basic prediction included:

Initial tests of the burst were successful but "a faster but somewhat erratic hemispherical wave in the atmosphere crept upwards and downwards along the magnetic line of force through the belt region."

* * Among anomalies at the post where the line of force returns to the



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earth's atmosphere in the northern hemisphere—the so-called conjugate point—over the Azores Islands, a bright auroral glow appeared in the sky and was observed from aircraft previously stationed there in anticipation of the event, and the complex series of recordings began.

* * Explorer IV, which had been launched on July 26, 1958, on its orbital path by the engine by an altitude of 50.11 deg to gather data on radioisotope interference, reported absolute intensity and position of the shell of high energy electrons. With a preage of 165 sec and an apogee of 1,373 mi, the vehicle had been back and forth through the shell some 250 times before its primary instruments died on Dec. 6. Shape, position, decay of intensity and angular distribution of the radiation were measured.

* * Rate of decay of density in a function of altitude provided new information on the density of the remote upper atmosphere, since atmospheric scattering was the dominant mechanism for loss of particles.

* * There was no diffusion of electrons between the electron shell, since the intensity of the shell remained constant.

* * Although "the intensity had become barely observable above the threshold of natural radiation" at the altitudes covered by Explorer IV in late September, it appears likely, however, that the deep space probe Pioneer III de-

livered a small residual of the Argus effect at very high altitudes on Dec. 6, 1958. But the effect appears to have become inobservable before the flight of Pioneer IV on Mar. 3.

* * Electrons, traveling in helical paths along magnetic lines of force, could not be at least as far as 4,000 mi. This apparently was determined either by Pioneer III or by extrapolation.

Speaking at California several days before the *Washington* press conference, Dr. James Van Allen, director of the institute in which the radiation was discovered, said the earth lost important natural radiation belt electrons "although it, and he had been "specifically requested by a high government official" not to comment on the explosives used and that Pioneer IV served as the final radiation from the Argus shot.

Prior to the experiments, trapping bands ranging in number by electrons whose paths were as close as 100 mi to earth and rocks for those whose paths ranged in close as 2,000 mi had been predicted.

Argus experiments were decided on late last April after consultation with the President's Science Advisory Committee, Advanced Research Projects Agency, and the National Academy of Sciences, and were carried out in technological unison with Dr. Harlow York, who also directed the Air Force Cambridge Research Center and Stratospheric Research Institute developed, tested and operated a variety

of monitoring equipment at ground stations and aboard aircraft and ships. Air Force Special Weapons Center directed sensitive rocket work (see box) Armed Forces Special Weapons Project and Office of Naval Research also played major roles.

Navy Task Force 88 handled the Argus frags from the USS *Nimitz*. *Nimitz* *Seawolf*, Lockheed Aircraft Corp. provided the three modified K-17 rocket vehicles and a former Lockheed crew supervised the frags aboard ship.

The *Nimitz* was later inhibited from launching because of the extremely rugged radiation and believed that this might have been caused by U-3 explosion in Nevada or the Pacific.

Mercury Progress Detailed by NASA

Washington—National Aeronautics and Space Administration last week reported that "significant progress" has been made in the following four areas in support of the Mercury manned spaceflight project:

* * *Orbital trials* to determine optimum altitude for launching the maneuverable satellite, reliability of the satellite motion in its orbit during descent, survival in water and ground landing and recovery methods. Full-scale model capsules have been dropped from a USAF Lockheed C-130 transport at T-1, 30,000 ft, and West Point, Vt., and photographed in a Lockheed T-33 plane; the C-130's altitude and another at parabolic deployment altitude. Recovery was made by two Marine Sikorsky H-34 helicopters and an NASA search boat.

* * *Escape tests* Full-scale models are being tested at the Phillips Air Force Base Research Station, Wallops Island, Va., for reliability tests of the escape system, acoustics, stability of the capsule, configuration, ground survival of escape capsule, survival of escape and recovery methods during launch and descent.

* * *Model programs* Small test flight models were flown from an aircraft carrier off Wallops Island through the full velocity range to investigate maneuvering, reentry and atmospheric heating. Wind tunnels at Langley and Ames Research Center and USAF's Arnold Engineering Development Center are used in static wind-tunnel booster-capsule configurations up to Mach 30.

* * *Impact tests* Capsule will fall with a velocity of 1,000 ft per second from 10,000 ft. One test at the Langley facilities at Langley last month showed that the capsule's primary safety system was intact. Capsule materials now under study for ground landing include honeycombed corrugated plastic and aluminum and cellulose.

ARGO Rockets Monitor Argus

Washington—Effects of the high-altitude atomic explosions in Project Argus were measured by the launching of 21 instrumented ARGO I-2 solid rocket boosters from Atlantic Ocean locations during the period from July 7, 1958, to Mar. 24 as well as by the Explorer IV satellite, ground stations and aircraft.

ARGO II was an Atlantic Development Co. adaptation of a four-stage National Aeronautics and Space Administration instrumented test vehicle. Both vehicles use an Honest John booster, two Nike boosters in tandem, a Recruit and a T-33 motors.

Two ARGOs were used as test vehicles and 21 were fired before and during the time of the atomic explosions over the South Atlantic. Sixteen of these were considered to have been successful. Seven were Army FA, Paris, Kauai, Cape Canaveral, Fla., from which three were fired; five of them in a 24 hr period around Aug. 18 and NASA's Phillips Air Force Research Station, Fla., Nike boosters in tandem, a Recruit and a T-33 motors.

ARGO carried 400 ft. latency powered instruments packages and television cameras. Average orbital period was 550 mi.

In the first test flight, Aug. 19, 1958, instrument payload, provided by Lockheed Aircraft Corp., took off from the vehicle. Seven suborbital vehicles performed

instrumented flights.

Some ARGOs that were fired prior to the Argus explosions to take measurements of background radiation. Some of these were coincident with the high altitude atomic explosions at Argus I and Argus II which were part of Atomic Energy Commission's Redback series and picked up some Redback radiation, which is believed to have originated with Argus.

Argus payload was under the direction of Special Projects Division of USAF's Air Research and Development Command's Special Weapons Center at Kirtland AFB, N. M. Arrows were loaded field assembly and firing. Arrows modification of the basic vehicle was aimed at conserving it from the speed means for which NASA used it as an altitude mission.

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Atlas-Vega Can Boost Two Men Into Orbit

Prudhoe, Calif.—*Atlas-Vega* vehicle now under development by National Aeronautics and Space Administration will be capable of boosting two men into a close earth orbit with enough equipment to sustain them for several weeks. A later development, *Project Satena*, may boost the men into orbit for an extended period, and still another just now under development, *Nova*, may be used for manned lunar or planetary missions.

Present purpose and structure of the *Atlas-Vega* vehicle under development was described here by Dr. Alan S. Shulman, NASA's director of space flight development, at the colloquium on the *Review of Space Exploration* at the California Institute of Technology. They include:

- *Atlas-Vega*, with a Centaur Atlas first stage, a modified General Electric Co. X-105 *Vanguard* first-stage propellant at a second stage and a storable propellant third stage when used for lunar or planetary missions, will have as its primary function uncrewed exploration of the moon and deeper space. Close approach to a planet will require at least 1,000 and probably 2,000 lb. of equipment that is primarily for guidance and communications equipment. *Vega* and *Venus*, probably, will be the first vehicles developed that can carry payloads to this magnitude to the vicinity of Mars or Venus.

- *Satena*, with the I-151 liquid-*oxygen*/liquid-hydrogen cluster as a first stage booster, will have a gross weight of about 750,000 lb. and be capable of placing a 10-15-ton payload into orbit around the earth. Typical mission for this vehicle, *Satena*, would involve sending a crew of five into orbit with enough facilities to sustain them for several months.

Orbital Supply

Satena, he said, may well become the basic vehicle for orbital supply missions involving the transport of food and supplies to crews in orbit, the exchange of crew members and the transport of additional fuel and equipment.

- *Nova*, based upon a cluster of four 1.5-million-lb. thrust single-chamber engines, was described by Shulman as "the first vehicle of the series that could attempt the mission of transporting a crew to the surface of the moon and returning them safely to the earth." He said that, "with advances in the state of the art, it is not inconceivable that the crew flies to the moon in 20 years." It is conceivable that the *Nova* could be provided to transport one or two *Vega* flights on the earth moon and return mission. Four additional stages above the

(continued) there are required for the long return mission, including the rockets for landing on the moon, taking off from the moon and for entry into the earth's atmosphere.

Satena and *Nova* will have the capability of transporting payloads of approximately 75 tons into orbit around the earth if it is needed.

In Washington last week, NASA headquarters announced that a \$37 million contract has been awarded General Electric Co. for the second stage engine for the *Vega* space vehicle. Engine will

be modified to start at high altitudes and continue after a coasting period in space, in order to establish high altitude. It will burn kerosene and liquid oxygen as it does in the *Vanguard* vehicle but will have a thrust rating of 55,000 lb. It is to stand at the 28,000 lb. in *Vanguard*. Centaur is expected to get the vehicle contract for *Vega*.

Cost of development of the *Atlas* vehicle is estimated by NASA at \$245 million, and cost per man after development of \$5 million.

General characteristics of the optimum vehicle were also described by Dr. H. D. Langford, manager of Dr. H. D. Langford, manager of the Tennessee Space Workshops, who said it should have:

- Mass of the power supply should be approximately equal in mass of the payload.
- Exhaust velocity should be approximately equal to the velocity which could be imparted to the mass of the propellant alone if its entire energy output were consumed in leaving its stage. The velocity she would be approximately the net residual in speed which can be imparted to the entire rocket if payloads are small.

- A suitable specific propellant weighing 1 to 1.5 lb./kilogram per kilogram would be selected at a propellant density of 0.646, or less. Mass times the nine times this acceleration could produce escape from the earth's gravitational field, providing the vehicle was first launched into satellite orbit, he noted.

Specific Requirements

Comparing specific requirements between solid and chemical propulsion systems, Dr. Langford said a rapid top to Mars, using as one system and powered by a plant weighing 10 kilograms per kilogram, will give performance equal to that of a chemical system with a specific impulse of 300 sec. Using 10 kilograms per kilogram could be attained by a specific impulse of 900 sec.

Development goals described by Dr. Langford are "first, to generate instantaneous chemical power in the range from several kilowatts per pound for weeks or months with a plant weighing as few kilograms per kilowatt as possible that could and continue to develop conventional problems. Secondly to attain matter acceleration in the range of 20 to 100 kilometers per second in less time than the range from 1 kilogram per day upwards, so as to develop thrust ranges from a few grams upward, with savings of only a small fraction of the energy."

Communication requirements for



Atlas Ablation Cone

Although it covers the ablative type cone once planned for atmospheric reentry and fuel for the first two in *Atlas* vehicles, the cone recently was successfully test fired with a solid propellant ablative-type cone fired on a *Vega* flight of about the same time as what successfully flight tests were from Cape Canaveral. The

vehicle which will probe the edge of our solar system, probe unique path lines, according to Dr. Eberhardt Rechen of Jet Propulsion Laboratories.

Dr. Rechen also asserted that one of the missions of space exploration must be its economic aspects.

Stations in the U.S. and in Europe will be used to conduct experiments in space contracts planned early next year, and materials said Dr. Rechen said.

As part of the economic test batch of a satellite program, Dr. Rechen said several companies have already completed studies on launching a communications satellite at their own expense. Such a satellite could be used for radio and telephone communications on a commercially profitable basis.

If a vehicle can send into the U.S. would have to be consistent with the problem sent in it, the speaker continued. However, conceivable name would be available to build the ground portion of the communications equipment, since a vehicle would be required to be launched at least once in order to take at least four years to reach the edge of the sun. Dr. Rechen posed another question as to when a mass probe vehicle should be launched. One ordering high speeds technology to advantage, it is quite possible that a basic vehicle, launched one year from now, would reach the edge of the solar system at the same time as a vehicle launched today. How long shall we probably wait? he asked. Dr. Rechen estimated that about three years from now would prove optimum.

Communications will be plagued by Doppler effects related to the speed at which the vehicle is moving from the earth. Normal users would need a 10-15 rpm rotation at 1,714 rpm to appear to move at 271 rpm of propagation, Dr. Rechen said.

Referring to *Satena*, Dr. R. P. Johnson, at Thompson Ramo Wooldridge, said the cost of putting a manned space craft on the moon would be an estimated \$60 million. He said the project would require a force of 200 scientists, working for five years.

Dr. Ernest Stenling, director, Research Projects Laboratories, Army Ballistic Missile Agency, said that the instrumentation carried by space probes so far is mostly to help probe for "the exploration of space, and the instruments are not necessarily built in. There is a better instrumentation which must first be developed to ensure man's survival, he said, noting that one minute of arc over a distance of 10 million miles would cover a lateral separation of 16,000 m beyond capabilities of present earth orbital navigation systems. To probe the unknown, however, would require manned space probes since instruments can only measure what they are designed to measure."

Nuclear Plane Contracts

Washington—Contract Division of General Dynamics Corp. has been selected by Air Force to work on the initial design of an aircraft for a nuclear-powered bomber, winning it a design competition over the Martin, Ga. Division of Lockheed Aircraft Corp.

Machinery of the work leading to a nuclear aircraft will continue to be concentrated at present, development which is being conducted by the Nuclear Propulsion Division of General Dynamics.

Contract will now begin to work directly with CE on problems affecting both the aircraft and the aircraft.

Lockheed design work will be supported by the Air Force at Lockheed Aircraft Corp.

The Lockheed Nuclear Laboratories north of Atlanta will continue its experimental study on the effects of nuclear radiation on materials.

As part also is a funding for construction of a nuclear test laboratory at the Lockheed Aircraft Nuclear Engine Laboratory of the Pratt & Whitney Aircraft Division of United Aircraft Corp.

The new aircraft laboratory with seven test cells will make it possible for Pratt & Whitney to conduct nuclear experiments at its own plant rather than at the Lawrence, Calif., laboratory, or in Los Alamos in the West. Pratt & Whitney is engaged in the development of nuclear cycle nuclear engines for aircraft under Atomic Energy Commission contract.

Airframe Companies Report Record Sales

Continued emphasis on development and the theme of 1958 annual reports was the theme of 1958 annual reports for the three Lockheed aircraft companies at the end of 1957 to 1958, and:

• *Lockheed-Atlas*, \$562,676,000, compared with \$564,315,000 in 1957, earnings \$58,517,000, or \$1.17 a share, compared with \$60,132,353, or \$5.85 a share, in 1957.

• *Lockheed*, \$562,676,000, compared with \$564,315,000 in 1957, earnings \$58,517,000, or \$1.17 a share, compared with \$60,132,353, or \$5.85 a share, in 1957.

• *Chance-Vought-Solar*, record sales and earnings.

Positive outlook rated for the three, with Lockheed the most optimistic because of growing missile and electronic contracts, and *Chance-Vought* also. The *Lockheed* division in 1958 had an improvement in 1959, *Chance-Vought* said, and earnings at year end were \$1.346, 188,000 for 1955 and \$1.288,000,000 for 1957. Sales for 1958 are forecast to include \$67.1 million in missile and satellite programs and \$264 million in communications equipment.

• *Chance-Vought-Solar*, Inc., \$19.8 million, \$147,579,000, compared with \$169,817,856, earnings \$6.51,120,965, or \$3.45 a share, compared with \$8,702,631, or \$4.35 a share, in 1957, backlog at the end of 1958 was \$405 million compared with \$152 million a year earlier.

Northrop Corp., in report for the year ended June 30, 1958, had sales of \$11.6 million compared with \$12.5 million for the same period a year ago and earnings of \$1.144,701 or \$1.97 a share, compared with \$2,864,595, or \$1.02 a share a year earlier. Backlog was \$10.4 million, a drop from \$27.5 million in 1957.

Other aircraft reports included the following:

- *Boeing*, Aircraft Corp. first half sales for the period ended Jan. 31, 1958, total sales of \$11,746,873 for the same period a year ago to \$1,757,811 but net income earnings dropped from \$1,210 to 96 cents because of the sale of 300,000 shares of stock to the public. Total tax adjustment in the total sales were \$979, to \$591 million from \$641 and total backlog was \$213 million compared with \$745 million at the end of July 31, 1957.

• *Grumman* Corp. first half sales for the period ended Jan. 31, 1958, sales of \$11,746,873 for the same period a year ago to \$1,757,811 but net income earnings dropped from \$1,210 to 96 cents because of the sale of 300,000 shares of stock to the public. Total tax adjustment in the total sales were \$979, to \$591 million from \$641 and total backlog was \$213 million compared with \$745 million at the end of July 31, 1957.

Sikorsky Designs HSS-2 as ASW System

By Robert L. Stanfield

Sheldore, Conn.—Sikorsky Aircraft's new HSS-2, twin-turbine-powered, amphibious helicopter, designed from scratch as an anti-submarine weapon system and tested out here last week, will be the Navy's first self-contained system that can both search out and destroy enemy submarines and still survive extensive damage repair.

First deliveries will be made to the Navy in late 1968. The service has awarded \$12 million contracts to Sikorsky for development and production of the HSS-2, and serial production is under way.

The HSS-2 was produced and flown 15 days before the first production aircraft was accepted. It was first flown publicly last week, prior to which it had had 1 hr. of flying time. The helicopter was powered by two General Electric YT58-GE-6 engines with a horsepower of 1,930 shp. each. Engines weigh only 271 lb. each, including the optional main rotor system gear of 77 lb. Weight reduction at the turbines, compared with previous engines, also means reduction in the helicopter's empty weight and consequent payload increase in payload.

Delivery of production engines—YT58s with 1600-shp. each—was last week. The engine has a weight of 219 lb. (dry) and flying weight of 161 lb. Each engine has a maximum delivered 1,120 shp., weighed 155 lb. and legal specific fuel consumption at 0.615 lb./hr./shp. The helicopter incorporates both gust and pressure fueling. In flight fueling is currently being tested.

The HSS-2, in the weight class of a medium transport helicopter, meets Navy requirements with its both land and amphibious operations. The aircraft is capable of single-engine operation with a 100% margin, according to Michael E. Cichanoff, Sikorsky engineering manager. Maximum single engine speed approaches 107 kt.

Radius diameter of the HSS-2 is 62 ft. Width is 36 ft. and length, from front of the hull to the tail rotor, is 54 ft. 9 in. Height, which drops down to top of the rotor, is 15 ft. 4 in. Diameter of the tail is 10 ft. 8 in.

The helicopter will have a nuclear depth search as well as conventional warfare capabilities. It will be fitted with four long-range radio, be compatible with the HSS-1, which can carry two Mk. 43 homing torpedoes (AW Sept. 1, 1965, p. 55). It is said to provide 5% times more distance than the HSS-1 if required.

Mission capabilities include post-encounter hovering, turnabout at low altitude

(10 to 100 ft.), day and night, plus the ability to stay up for extended periods. It has "twice the amount of endurance we have now," said Col. Allen R. Yates, director of the Bureau of Aeronautics antisubmarine branch.

The HSS-2 rotor envelopes for all-bladed blades which are interchangeable within the main and fore tail rotors in minutes. Both the main rotor and the fore tail blades fold under the extended clamshell upper construction. Rotor blade antiicing equipment is provided. The rotorfold is the jettison Schenck carburetor-powered. Antifouling boots with a heat bell (the first ever on the single-turbine) 3-62.

Sophisticated as a helicopter yet, the HSS-2 will be fitted with several options to increase its anti-submarine operational value, including a search-and-rescue system, a nuclear weapon delivery system, and other operational capability. Fully automatic blade folding equipment facilitates storage in hangar or aboard ship. The fore fold is forward on the right side, clamshell folding over forward.

Propulsion power in the HSS-1N (S-18 with all-weather capability) and the HSS-1F (modified T-58 testbed) went into the making of the HSS-2. Basically, it is a conventional mainfore-tail structure—with everything built around the hub. HSS-2 is basically a composite aircraft with few applications of steel except in the tail boom, and aluminum casting for the frame. There is extensive application of plastic film for thermal, fatigue and stress.

Most of the avionic equipment is grouped in the nose compartment. The nose can also tolerate detection equipment. Both the left and spacious, under-the-rib compartment, which we mounted, are watertight and compartmentalized. Fuel is carried in cells housed within the tail structure.

Raw data range-type forward-looking data is housed in that the two nose fairings fold outward, one down and one up. The lower section, which folds down, contains enough space for two cabin seats.

Ease of maintenance and ease disassembly of components were incorporated into HSS-2 design. Helicopter's engine cooling cowlings and covers in a serv plenum. The transmission and clutch plates fold down so that a mechanic can climb up probuctly steps on an aircraft and make his checks.

The tail drive shaft housing can be quickly opened via piano-type hatches, for maintenance accessibility. The leading and trailing edges of the tail rotor blades are fiber-toughened, also qualify linkage to provide access to controls and hydraulic system cable housing.

One lightweight radome engine can be pulled out in less than 30 sec., by two mechanics using appropriate special support equipment provided by Sikorsky. Michael Theodore, assistant project engineer, told *Aerospace Week*, Massuted jobs by side above the fuselage, the engines allow more cabin space and better visibility. Small size of the engines led to the mounting of accesss on pads on the back side of the transmission.

Three hydraulic systems—primary, secondary and utility—provide for primary servos, secondary servos and gear blade folding and other minor hydraulic equipment. Concentrically gear also has primary system for emergency landing. The horizontal stabilizer is driven by a electrical motor.

Power assistance is provided with 400 lb. capacity main load control on right side of the helicopter. A 6,000 lb. capacity automatic breakdown release cargo door can be installed in any external load.

Development of the T58-GE-6 engine has been concurrent with the airframe, still to be refined in the full production life. The engine comprises a 10-stage, seventh speed (first two stages shortened), axial flow. Military rated speed is 20,700 rpm. Compressor static is at a right cylinder steel casting with 11 rows of blades. Other casings and housing is all in one (no deg. temperature compensation). Status had nearly eight on each of two engines folded over mounted on the front of the rear fuselage.

Power turbine operates normally at 19,380 rpm, and is reduced to 6,000 rpm through reduction gears. Length of the engine is 55 in. Diameter is 36 in. Present ratio is 8.51. Military idle is 0.67 lb./hr./shp. Specific weight is 0.265 lb./shp. Compressor airflow is 11.24 lb./sec.

During qualification tests, the engine, as addition to delivering 70 lb. more than its specification, met weighing 15 lb. less than specified weight, made 42 fully automatic starts, all before the starting time guarantee, according to General Electric. Horsepower and its determination—2,687 and 1,273%, respectively—was well under the 9% regulation limit.

Transport version of the HSS-2—the S-61—with three YT58-GE-6 turbine engines, will have a 10-ft.-longer fuselage, with the extension between the cockpit and midsection section of fuselage. A mockup is being prepared at Sikorsky's plant for design at Firm in three months.



SIKORSKY'S HSS-2, twin-turbine-powered amphibious helicopter, will give the Navy off-weather capability for anti-submarine warfare. Power is supplied by General Electric YT58-GE-6 turbines currently generating 1,930 shp. each.



Joint Chiefs Detail Budget Defects To House Appropriations Group

By Paul Entwistle

Washington—Joint Chiefs defense budget of \$41 billion is adequate to meet current needs but could allow future U.S. capabilities, the House Appropriations Subcommittee was told in executive testimony made public today.

Military chiefs and service secretaries agreed that Joint Chiefs' budget could provide for all defense needs for the present but left open unpredictable entries over the programs that have been, or will have to be canceled, delayed or cut back in order to stay within the Administration-imposed \$41 billion budget limit.

Lack of funding, especially on long lead time items, they said, might result in design gaps within the next four or five years. Gen. George C. Marshall (D-Tex.) underscored that arms and the services originally estimated total needs of \$48 billion for fiscal 1960 to fund current and known future requirements.

What's Needed

The respective service chiefs indicated to the committee that more money could be used for the following programs:

- An F-105B/Manned aircraft procurement; continuation of a nuclear-armed aircraft, missile procurement, satellite construction and operation and maintenance.

- Army—Replacement, modernization and an increase in the number of equipment, funds for aviation personnel strength of active Army and reserve forces, procurement of heavy-duty vehicles as a mobile mobile system, and adequate procurement of man-to-boat vehicles.

- Navy—Maintenance and modernization of ships and aircraft, procurement of new ships, aircraft and missiles, acquisition of antisubmarine warfare procurement, fleet ballistic missile weapon systems, and increased research and development effort.

Adm. Arleigh Burke, chief of naval operations, said the U.S. will be "in a very bad state" about 1965 and 1966 because the Navy might not be able to carry out its current anti-submarine warfare mission within the next few years unless the service is able to replace most of the fleet which will be obsolete at that time.

Gen. Maxwell D. Taylor, army chief of staff, did not criticize the lack of funds for the Army program. He was critical, however, of the method of all-

the reporting of transfers. "That is why additional funds will have been included for procurement of additional Hound Dog to prevent slowdown in sales for the B-52s and for continuing development of the B-70."

Manned Reacher Force

"The Defense Department plans to maintain a manned bomber force despite expense both in size and in quality to that of the U.SSR," McElroy said. "In addition it also intends to have a significant capability in ICBMs, so land-based intermediate range ballistic missiles, so submarine-based Polaris missiles, and to maintain bombers."

McElroy admitted that a surprise attack of a large number of ICBMs and IRBMs carrying nuclear warheads could inflict severe damage to the U.S. and its allies but such a strike would not be strong enough to prevent a retaliatory force from knocking out the attacking country.

As a result, under these circumstances, he did not think such an attack would be launched.

Measuring of Superiority

He stressed, however, that the margin of superiority will remain as the ICBM comes into the arena of the two countries that the U.S. and Russia will live in peace with a defense against the missiles that have developed.

McElroy said he recommended against going into production with the Army's M-100 Zeus until more information is available to him that its capability of accomplishing its objectives is not near at hand.

Instead, he said, he felt the money should go into further research and development work.

Solar Awarded NASA Thrust Chamber Job

Los Angeles-Solar Aircraft Co. will produce new lightweight rocket thrust chambers for a research vehicle being developed by the National Aeronautics and Space Administration.

Chambers will be formed with a ring of U-shaped channels enclosed with a braided wraping of fine gauge metal ribbon. The technique, conceived and developed at NASA's Lewis Research Center under the direction of Edward P. Bach, will permit greater flexibility in design and more effective cooling while reducing weight.

Thruster chambers will be 5 ft. in length with a 10 in. diameter exhaust nozzle and will be made of a high temperature stainless steel alloy and provide 1,000 lb. thrusts over rates involving the completed chamber to manu-

facture 1,000,000 lb. of thrusts over the life of the program.

Gen. Thomas D. White, Air Force chief of staff, told the committee that the USAF budget does not represent a concern regarding the amount of funds available if it would result in a cut that would not seriously affect the overall strength. He added, however, that any new intelligence information on the potential Soviet attack capabilities or technological breakthroughs in research and development could force a re-appraisal of the budget and bring a request for more funds.

Military Support

Deputy Secretary Neil H. McElroy strongly supported the budget in all aspects and assured the committee that the "nation is prepared to meet the present threat."

McElroy and the defense budget will provide for the continuation of about the same level of man and material resources as planned for the end of the current fiscal year. The Army will continue to support 14 divisions and other units, the Navy will operate 364 attack ships, the Marine Corps will continue with three divisions and shore wings and the Air Force will have 162 combat wings, three less than that planned for the end of fiscal 1959.

At the same time, McElroy admitted to the committee that Russia has the capability of producing a greater number of aircraft and missiles than the U.S. within two to three years but said that this fact did not necessarily represent a cause for alarm.

The reason why the Defense Department does not plan to produce the number of ICBMs the Soviets are estimated to be capable of producing, McElroy said, "is that in the judgment of the President, National Security Council and military experts, there is no particular logic in trying to match everything our opponents might do."

Emphasis Rule

In the judgment of the Department the most important task is still the principal one of protecting the nation from a nuclear blow and continues to be the most important element of the retaliatory forces for some years to come.

That is why substantial funds have been included in the budget for procurement of additional B-52s, B-58s and

the supporting air forces. That is why additional funds will have been included for procurement of additional Hound Dog to prevent slowdown in sales for the B-52s and for continuing development of the B-70.

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First Photo Shows Hound Dog Aerodynamic Configuration

Trimmed test model of Air Force GAMET Hound Dog airframe struts is mounted under the wing of a Boeing B-52 testbed. Test version has the same environmental characteristics as the operational model, built for USAF in North American Aviation. Test model will be ground and air tested at Boeing Field, Seattle, Wash., McCord AFB, Wichita, Kan., and Air Proving Ground Center, Eglin AFB, Fla. Hound Dog's engine is a Pratt & Whitney J75, thrusting 13,000 lb. st. *Inset*.

Glennan Asks Review Of NASA Patent Policy

Washington—National Aeronautics and Space Act provisions, which requires that the government often take its interests growing at the cost of private firms, for the National Aeronautics and Space Administration has forced up the agency's costs, according to NASA Administrator T. Keith Glennan.

Glennan told the Senate government-industry meeting of the Electronic, Electrical, and Space Act, here, that he felt the Congress will want to review this entire series of patent rights. Pointing out that the Defense Department, operating without such statutory restrictions, tends only a results fee license to inventors coming out of its classified work, Glennan contended that "few such robust patent policies followed by government agencies work as a classified related field of science and development, can be detrimental to the kind of innovation that we need from our scientists."

The NASA administrator has attempted to make these patent rights of the public sector to be clearly in the public interest, Glennan said. He added that NASA will hold public hearings on various as yet classified areas of science and technology.

Glennan said that his agency will require contributions from members of the electronic industry on three areas:

- Design and fabrication of certain products

- Tracking and data acquisition-reduction systems

• The guidance and control systems.

NASA plans to launch an infrared 100 ft. diameter telescope related to this, this will be used as a passive sensor instrument, solar with two more scheduled for launching in 1960. Radio signals will be beamed off the satellite using the NASA's Jet Propulsion Laboratory and the National Space Laboratories at Goldstone, Calif., and the Bell Telephone Laboratories facilities at Holmdel, N.J. Glennan expressed the hope that one or more industrial organizations might want to participate in these experiments.

Computer Circuit Cuts Aviation Unit Weights

New Task-Novel microelectronic solid-state circuitry development, which should permit a 100- to 900-fold reduction in size and weight of a more complex electronic circuit and space can be made available to NASA's laboratories, Inc.

The microelectronic computer developed by the University of Illinois, Urbana, is a single crystal of silicon with a resistive metal network, only 1/10 in. thick. It performs a function that normally would require two separate transistors, two resistors and eight resistors. The company also has developed a planar solid-state circuit, a single semiconductor crystal, using the same controlled masking, etching and diffusion techniques from a single silicon wafer.

Task-Novel researchers say the technique should make it possible to trim the equivalent of 25 million components

into a cubic foot of volume, compared with the 50,000 per cubic foot obtainable using the present microelectronic construction techniques. The new technique can be used to produce microcircuits incorporating transistors, and solid-state resistors and capacitors, which makes it suitable for mini computers and can be used in space.

The company has not yet developed a semiconductor equivalent of an inductor, but currently is working on this problem. It intends will come up with additional circuit applications.

Task-Novel's circuitry is now being used in several aerospace applications to apply new solid-state circuitry to aircraft and to the technique is rapidly adapting to aeronautics, the company says. Development was sponsored with NASA's Langley Research Center and the Navy's Bureau of Ships.

Task-Novel researchers also announced a new gallium arsenide diode which can be operated at temperatures up to 132°C, about double the temperature of silicon diodes. This diode, rated for 900 mampere at 25°C temperature, is reported to be the first of a family of new extrinsic high temperature gallium arsenide semiconductor, including transistors.

ARPA Official Raps U.S. Space Pace

By J. S. Bata, Jr.

Daytona Beach, Fla.—ARPA is not planning to move into space at once with space speed and is neglecting a vital component in its program by failing to immediately begin development of large maneuverable manned space vehicles which can transfer orbits and travel freely within bounded orbits above the earth according to David A. Young, chief of the Advanced Research Projects Agency's Space Technology Branch.

ARPA has conducted preliminary studies concerning such vehicles under the designation MBS-V (Maneuverable Recoverable Space Vehicle), but Young and his funds have yet been provided for actual development work.

Rocket Society Address

In an address at an American Rocket Society flight testing conference last fall, Young said the development of MBS-V vehicles was possible and indicated state of the art, and that they should be in an advanced hardware stage about three years from now in order to take full advantage of the growth in the U.S. space exploration test program.

Thus planned development started 1962, as cited by Young, would suffice to place a 25,000-lb. unit in low orbit and a demonstration in flight

not long after the ability of boosters to load and function efficiently in space and fuel return to earth.

If a large maneuverable vehicle is not ready as an immediate replacement for the MBS-V capsule when the program is completed, Young believes that the U.S. will not have the chance to become clearly superior to the Russians in space activity in the near future.

A MBS-V type development program, possibly using the McDonnell Douglas X-20 Dyna-Soar as a model, should immediately take advantage of its findings and be ready for service shortly after MBS-V is completed, according to Young. He said, however, that given his experience, satellites are advancing about our total energies, leaving the question for him and the development of maneuverable vehicles in the unfinished future."

National Aerospace and Space Administration has \$1 million committed in the fiscal 1968 budget for the study of a Jettison on return for the MBS-V capsule. Presently, this will not allow a maneuvering vehicle other than that being developed by ARPA.

Young indicated that MBS-V vehicles now being considered would weigh 20,000 to 25,000 lb. as compared with about 1,000 lb. for the MBS-V capsule.

Almost half of the weight of the MBS-V vehicles would be devoted to

propellants and the propellants used account to change orbits and return to earth. Cheaper fuel systems probably would be used initially for this purpose, but, according to Young, more less thrust high efficiency propellants such as sea water are far enough along to be seriously considered. These units would meet the required weight for orbital gear and fuel mass when they're given a solid design base to complete the design process. However, this will be the basis of making many space vehicles per flight.

While some debate is still going on within U.S. scientific circles as to the military usefulness of space vehicles, there is little doubt about the preceding opinion at ARPA. Ray Johnson, ARPA's director, has told Congress that "the United States will, at a cost of its own national security, require the right to build to operate maneuverable vehicles in outer space, in much the same manner as our jet aircraft perform."

In his address, Young said that MBS-V vehicles could be built into roughly the same size as a large communications satellite that has been communications equipment shared by an atmospheric scientific laboratory. MBS-V could maneuver in the orbit and meet the scientific, service and acquisition requirements of a regular communications satellite. Young said, "Several satellite orbits might be created in the MBS-V vehicle before it returned to earth. MBS-V also might be used to clear space by at certain orbits to useless satellites and then sending them into an orbit to rendezvous the earth so that they would burn up."

Space Approach

Another strong ARPA opinion concerning the proper means of developing military space vehicles was outlined by Young. "I hope to make the first MBS-V unit, or any type of space vehicle, strictly research work rather than fall into the trap of a weapons system approach. And do it first flight with the multitude of considerations in mind in the raising and launching of systems."

Thus experimental vehicles, probably would come under ARPA control initially, the development of which were completed. They and the data they had provided would be turned over directly to a military service for the development of a weapons system. ARPA believes that this approach is compared with the weapons system concept would

Navy Space Plan

Daytona Beach, Fla.—Navy hopes to build five 10th research satellite that will roll out to two sophisticated space vehicles for navigation and one for global communications. Preliminary designs have been completed on the two systems, which are being developed under the aegis of Defense Department's Advanced Research Projects Agency.

In the future, navigation systems will consist of six satellites in staggered orbits so that all orbits always will be overlaid. "They will be in high and stable orbits so that the Navy may more accurately gauge the location of the satellites at any time of the day, and navigation may determine their position from them to the nearest one possible with the data."

Adm. Arlo T. Heywood, assistant chief of naval operations for research and development, predicted here that it will be possible to determine the position of a mobile space vehicle or satellite within a radius of a mile using this sole powered satellite navigation system and that it may effectively supersede LORAN and other radio navigation systems. Adm. Heywood indicated that this probably would represent the first time that a space system would be less expensive than the conventional systems that it replaced.

The communications satellite would control coverage, storage and broadcast equipment similar to, but more sophisticated than, the apparatus used in Project Sounding-6. Army satellite with experimental communications equipment should probably will provide the first Navy experiment, and it will not cost some of the components planned for the Navy system.

Rockwell officials to launch the series of experimental satellites and final operational models have not yet been selected. Adm. Heywood indicated that, if possible, the Navy will use time by trying to get the 90s units into orbit faster than the new planes by other agencies.



United F-4 Phantom fighter aircraft. Photo: US Navy directed by McDonnell F-4.

SPARROW III AND CECO . . . On the Navy's team of advanced air defense weapons, the radar-homing, air-to-air missile Sparrow III promises to play a starring role.

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cal fuels, solving the problems of extreme temperatures and vibration, extrapolation of data for space applications, and recording test data under conditions never before simulated, are only a few of the research and development areas presently being explored by engineers in Marquardt's Test Division.

Engineers and scientists whose training and experience qualify them for responsible positions in the analysis, design, and operation of such advanced facilities will find full opportunity to demonstrate their talents at Marquardt. For an interview contact Mr. Floyd E. Harris, Manager of the Professional Personnel Department, 36547 Setzoy Street, Van Nuys, California. Roy E. Marquardt, President

1—Test Division engineers under Chief Engineer Leigh Dunn develop power and control devices and programs in Marquardt's power and motion test facility. Professional engineers wishing to join this creative engineering environment will find opportunities in many fields, including:

2—Facility Design—Engineers experienced in design, mechanical and thermodynamic analysis of industrial processes including systems for liquid air flow, sheets, foils, pressurants, and coolants for both cryogenic and extreme temperatures.

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Major Reorganization of Navy Proposed

By Cecil Bowles

Washington—Navy is phasing its major reorganization of its management structure with primary emphasis upon consolidating and upgrading the status of its research and development effort, tightening planning procedures and abolishing service overlaps of authority and mission.

Recommendations for the reorganization, made by a seven-man committee headed by Under Secretary William B. Franke, are scheduled to be issued soon by Navy Secretary James S. Gates Jr., by May 1. They include:

- **Establishment of a new Deputy Chief of Naval Operations for Development with three-star rank and wide ranging authority to succeed the present two-star Assistant Chief of Naval Operations for Research and Development. This officer would be charged with integrating and coordinating the overall Navy research, development, test and evaluation programs.**

- **Creation of an Assistant Secretary for Research and Development as one of the three mission assistance packages provided authority by the Defense Department Reorganization Act of 1973.**

- **Merge of the Bureau of Ordnance and the Bureau of Naval Weapons into a new Bureau of Naval Warfare in order to reduce "commander-in-chief" levels of operational responsibility and split management" under the present system. New east would be Navy's largest bureau with approximately 4,400 military and civilian employees in Washington, another 200,000 in the field, and would approximate about 85% of the Navy's total research and development funds.**

- **Restoration of the duties of the Director of Naval Operations for Air Ops to the level of a major air plans group, re-imposing planning and sales. Present would receive from the Office of Coordinator of the Air Materiel Agency and the present division of General Materiel, Flight Services (less the civil aviation liaison branch), Air Warfare and Naval Weather Service.**

- **Establishment of a Naval Technical Corps with "means of appurtenant facilities and career development" and elimination of the present restricted line designation.**
- **Creation of a top-level policy council to review military-aviation combatant and non-combatant force composition of policy review." Council would be headed by the Secretary of Navy and composed of the under secretary, the chief of naval operations, commanding officer of the Marine Corps and the vice chief of naval operations.**

Secretary Franke estimated that the proposals, if approved as expected by Secretary Gates, will require a year to implement, another four years "to smooth out."

Engineering input of the committee datum is the proposal for the creation of a deputy chief of naval operations for development whose authority would cover several present management levels and consolidate most of Navy's research and development effort and authority into a single authority. Other areas of the proposed deputy would be aligned by service interests. Eventually, he would have responsibility for:

- Coordinating and directing the efforts of the bureaus and offices of the Navy Department "in meeting approved research and development programs in accordance to ensure an integrated effort continuously responsive to long-range objectives, associate improvements, field innovations and advancing technology."

- Coordinating the various Navy research and development programs, including field liaison, new, performed by the Office of Naval Research. Present responsibility for this function as the Office of Naval Research would be transferred to the new officer.

- Other bureaus in the office would include the General Materiel Bureau, the deputy chief of naval operations for air and the research, development, test and evaluation bureaus and personnel of the Defense Warfare Division, the Surface Warfare Division, the Atomic Energy Division and the Air Warfare Division.

- In recommending the creation of the new post, the committee noted that the "complexity of naval aviation, including the development of aircraft, the acquisition of anti-submarine warfare and air defense, and the acquisition and use of space, for military purposes greatly increased the demand for direction, development and adaptation of new equipment and new techniques in aerial warfare."

- To make room for the new deputy chief in the Navy organizational table, the committee recommended that the present post of deputy chief of naval operations for administration be redesignated and transferred to the post of assistant vice chief of naval operations director of naval administration, reporting directly to the vice chief of naval operations.

- Under the plan, the Office of Naval Research would remain virtually unchanged, maintaining its general responsibility for establishing and maintaining basic research for the Navy and for maintaining contacts with scientific or

research organizations outside the Navy as well as for making contracts for the Bureau with educational foundations and nonprofit organizations.

However, the function of scientific data collection and development engineering, including editing in the research and development program now performed by the Office of Naval Research would be transferred to the office of the deputy chief of naval operations for development.

The committee recommended the merger of the Bureau of Ordnance and Bureau of Ordnance to produce a "supplemental supervisor" for the total weapon system effort within the Department of the Navy. Such a merger would consolidate:

- Five approximately two-thirds of the total development effort of the Navy and much of the weapon system development under the direct authority and control of a single executive.

- "Bring within the cognizance of a single bureau most of the triplexion of responsibility for flight cognizance, weapon system development (with particular reference to flight cognizance within aircraft and between missiles and aircraft)."

- Coordinate and amplify the funding of major weapon system programs in an effort to expedite the development process.

- Expedite the timely development and procurement of all components of a weapon system.

- Promote economy through more efficient use of facilities and laboratories.

- The committee said such an organization should provide an "efficient and effective" structure for the establishment of organizations similar to the Special Projects Office. The committee recommended that the Project Manager be made also the project leader in its specialized area in either of either branch. The Project Special Projects Office, however, will continue until the entire system is in aerial operations.

- If the merger is approved by Secretary Gates, enabling legislation must be sought and approved before the new bureau liaison can be established.

- Transferring of the duties of the office of the deputy chief of naval operations for air will bring up approximately 45% of its present personnel, leaving with the present responsibilities of strategic weapons for future aircraft and air-to-air missiles, aviation procurement, training and safety.

- The Naval Warfare Service Division would be transferred to the deputy chief of naval operations (flight operations and readiness) and the air reserve programs by the deputy chief of naval operations.

Committee (personnel and naval research) under the proposals.

The committee, in recommending open analysis of the office of the deputy chief of naval operations for air, said it "was felt that the need for a single authority to be responsible for a volume of authority held by the Office of Naval Research" and that the office should be decentralized and that all of its functions should be transferred to other offices. Committee cited in some offices "and indeed some members of the committee" included opinions that the office office be follow the organizational pattern of the remainder of the office of the chief of naval operations, tends to divide Navy into aviation and nonaviation groups and prevents full integration of the executive officer throughout the organization of the office of the chief of naval operations.

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In proposing the establishment of a Technical Corps within the Navy and the abolishment of the "instituted line" category, the committee said the letter designation "would continue and in the least of the problems." Restricted line officers, it said, "should be placed in a more distinct category than their special responsibilities." Other categories of line officers, it said, "should be established to give them a recognized, rightful place in the personnel structure of the Navy." Their particular specialties should be emphasized or given special designations within that corps.

Present group of restricted line personnel would retain their general line status until they were promoted to the rank of captain. The rank would be established to give them a recognized, rightful place in the personnel structure of the Navy. Their particular specialties should be emphasized or given special designations within that corps.

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Special duties, including communications, hydrography, logistics, air, naval intelligence, photographic, psychology and public information.

Other proposals recommended by the committee would merge the Eastern Sea Frontier and the Third Naval District and the Western Sea Frontier and the 12th Naval District, and make the director of naval communications an assistant chief of naval operations.

Members of the committee, along with Under Secretary Franke, were

Fred A. Barts, Assistant Secretary for Material; Adm. J. S. Russell, Marine Corps; Lt. Gen. M. B. Duane Johns H. Dohm, administrative assistant to the Secretary of Navy; Rear Adm. E. P. Holmes and Capt. John T. Moore.

Sputnik II Carried Corner Reflectors

New York—Soviet scientists apparently mounted corner reflectors on Sputnik II to obtain range data by radar and possibly to aid in orbital guidance, engineers attending last week's conference of the Institute of Radio Engineers were told in D. K. Barton of the Radio Corp. of America.

The Russian satellite was tracked at an altitude of 113 miles, on the AN/FRT-4 and 6 of last year, on an AN/FRT-5B microwave tracking system installed on Great Lakeshore Island off the coast of Michigan, Barton said.

Project Vanguard. On both occasions the radar automatically tracked the radio tag to the limit of the range tracking system of 268 miles, he said.

The results of tracking the satellite, according to Barton, were quite unexpected. A target with an effective radar cross section of 10-15 square meters is required at a range of 200 miles. For unity signal to noise ratio and the Sputnik II signal was about 20 dB above noise at that range.

Plot of the signal strength showed broad beams with a diameter of 20-30 arc, punctuated by a distinctive lobed or spike structure. Published data on the size and shape of the vehicle could not, according to Barton, explain the

Satellite Invitation

New York—Scientists of countries that have not launched earth satellites have been invited to design experiments to be carried aboard by Japan's M-1 satellite the Institute of Radio Engineers was told here last week by Dr. Lloyd V. Berkner, president of Associated Universities and chairman of the Space Science Board of the National Academy of Sciences.

Foreign scientists can either submit individual experiments grouped with experiments comprising complete systems packages which the U. S. will make available to place in either the upper or part of the payload of COSPAR—the Committee for Space Research of the International Council of Scientific Unions. Total cost per unit, National Research and Space Administration has been authorized to proceed with work on a U. S. research vehicle that will carry a payload proposed by COSPAR weighing between 100 and 300 lbs on an orbit between 260 and 2,000 mi above the earth within the next 10 to 14 months.

Geosynchronous satellite program has been suspended by Foreign Affairs Agency, seven months after its first flight. First geosynchronous satellite has been more than 200 hr. in the orbit since the launch program.

Lockheed Aircraft Corp. is establishing an Air Surveillance Warfare Systems Organization for the design and development of new ASW weapons, detection and classification systems, Unit, which will be responsible for organizing and evaluating all new ASW proposals by Lockheed will include experts in the fields of operation analysis, underwater acoustics, nuclear physics, aircraft design, tactics, ordnance, equipment, sonarography, data processing and electronics.

angle or distance of the signal, nor any reasonable extrapolation for extended, round or spherical shapes.

The satellite configuration that could explain the observed signals consists of corner reflectors mounted to inscribe the reference, over two square angles. Calculations from reflective theory show that one corner reflector would have an angle of about 90° and would reflect the lobe and spike structure observed.

It can be assumed that Soviet scientists depended upon successive radar observations to provide orbit data because the gain of the reflectors would fall off with the square of the frequency, as that Earth-orbit CBR data would see a cross-section of only a few square meters instead of the 1,000 square meters claimed by the 5,400 lbs AN/FRT-1B.

Analysis of the tracking data established that the relatively poor square tracking accuracy of the radar unit, El II, at other frequencies, and the vehicle could be tracked more accurately apparently because azimuthal signal spikes that it tracked clearly as viewed from the northeast at a rate of 1.5 deg per sec, and that a pair of range selection were used instead radial and feet apart.

News Digest

Brisbane claims a M-1 M-1 single satellite has an air-to-ground signal whose range is 71,899 ft for return range air craft in the 1,750-3,000 kilogram loaded weight category, having the necessary orbital work in 1,013 ft. The M-1 is expected 15 min to gain the last 100 meters of altitude above Maroochydore's Tandora Airport. Since the large In established an institutional road ahead with the M-1 (AW Mar 23, p. 20).

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CAB Begins Full-Scale Probe of ATA

Board of Governors after association's earlier stand, agree to cooperate with Board, Justice.

By L. L. Doty

Washington—Civil Aeronautics Board last week launched its full-scale inspection and review of the Air Transport Assn. (AW Mar. 23, p 36) after receiving a subpoena ordering the opening of the association's files.

The action was followed by a motion from ATA to hold the subpoena in abeyance "to protect the association's legal rights." Meanwhile, ATA board director, in a special meeting Wednesday, confirmed ATA's original position of willingness to cooperate with both the CAB and the Justice Department in their dual probe.

Prior to the *debutant's* meeting, however, ATA had reverted to its original position and told the Board it wanted to receive the right to look over parts of its files from the on-going inspection during the regular meeting of its directors April 7.

This switch in position came about when the Justice Department announced it wanted to conduct an investigation of its own and when the Board saw great value in having the inspection could be conducted with mutual collaboration.

The combined sources suggested that the Board investigation might in areas deeper than was indicated by the order which, in the winding, left virtually no field of ATA activity unanswered. As a result, ATA apparently took another reading of its position.

Subpoena Pending

Here are the events following the change in the ATA position that led to the issuance of the subpoena to the Board:

• Board denied the ATA request to keep certain of its files from the investigation and informed its intent to start the probe without new further delay.

• ATA then moved the date of its regular meeting from April 7 to Mar. 25 and asked the Board to defer the inspection until after the second date of the meeting. The Board agreed and it could not agree on this procedure but, on the next day, issued an subpoena ordering that files be produced Mar. 26. As a result, ATA was in default of the inspection period if it originally requested.

Meanwhile, the Justice Department made its move to begin its investigation and all pertinent arrangements following the letter requesting the probe have been made only between the ATA and Justice Department.

- File a list showing date and amounts paid to each member between Jan. 1, 1949, and the present date.
- Provide copy of statement of ATA's authorized budgets for the year 1950 through 1959.
- Release complete minutes of directors' meeting, meetings of the general membership and other meetings.
- File with the Board minutes of basic meetings of the directors and general membership.
- File copies of written opinions and reports submitted by the Air Traffic Conference enforcement office.
- File with the Board a list by subject matter, of all files destroyed by Air Transport Assn. and its contractors and to ATA's knowledge pertaining to ATA activities and the members' relationship with ATA, says Justice.

CAB Drafts Plans For Jet Fair Inquiry

Washington—Civil Aeronautics Board last week directed its staff to collect and file data on jet-fight transport operations as a first step toward conducting an inquiry into files for jet aircraft. At the same time, the Board advised media and consumers on the file over from the air transport industry.

Earlier, the Board approved jet regulation adopted by the International Air Transport Assn. on Paris last month on turboprop operations over the North Atlantic routes and certain Caribbean and South American routes. In January, the Board issued the order suspending of other changes proposed by American Airlines to route lines of Pan American World Airways.

In its order, the Board stated that "any relevant person having objection to the issuance of a final order regarding ATA's jet transportation rate and the calendar of ATA in file," the requested documents and records shall "admit" inspection within 10 days "and if so done, file, within month and supporting documents must be filed within 20 days" after the date of the order or Mar. 30.

In its order, the Board called upon the ATA and its members to show cause why they should not.

• File a copy of each resolution adopted by the ATA's board of directors and membership at general and special meetings.

The Board, however, reaffirmed its position that development of maximum jet transportation will depend upon adequate availability of service planes at the lowest cost economically feasible. It added:

To the extent that jet aircraft prove themselves to be more efficient than operations with piston-engine aircraft, it is their share every likelihood of doing so. We expect that the cost advantage of the aircraft will be reflected in the market through reduction in fares.

In opposing the jet marriage, the Board also opposed a 5% increase in one-way economy tourist and first class fares, round-trip fares and a 15% increase in air fare class fares on the North Atlantic.

Altimeter Misread In Viscount Crash

London—Crash of a British European Airways Viscount at Farnworth last April was due to the pilot's misreading of the altimeter by 10,000 ft, according to the official accident report.

The aircraft flew into the ground during its approach to Farnworth, altitude.

These were the findings. The Viscount was en route to Pitsburgh to pick up charter passengers.

Report by Chief Inspector of Aircraft F. G. Tweddle lists a lack of cooperation between the captain and first officer and lack of decisions on the part of the first officer in an emergency landing as factors.

The report says Capt. W. H. Brough failed to notice the position of the 10,000 ft pointer as he looked outside at the first officer's altimeter and reported the aircraft at 14,700 ft instead of 4,900 ft. It says he noted the same mistake when reading his own altimeter at 3,900 ft and 1,600 ft.

The pilot's errors, he believes, may have been due to the fact that the two cockpit windows in the aircraft are situated so close to each other that the pilot's eye is easily drawn to the other window, which can be misleading or ignorant, particularly at night," Tweddle said.

Tweddle expressed the opinion that Capt. Hard had "coordinated himself in handling the radio controls, writing down further reports, reading the approach and overshoot procedures, holding the first officer on a possible overshoot, attending to descent and initial approach, flaps and checking the objectives."

The report also suggests the first officer spent so much time trying to tune a transponder before leaving the aircraft that the plane passed him already but had been held substantially and other ads were sensible.

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Kolloman Denies Any Altimeter Malfunction

New York—Kolloman Instrument Corp. officials, including its engineers in the American Airlines Lockheed Electra crash at LaGuardia Airport Feb. 5, said that investigation of the instrument altimeter revealed no evidence of mechanical failure or malfunction prior to the crash except water damage.

Kolloman's vice president of sales, Frank J. Blitstein, who was one of the investigators, noted that the 900 ft. rise in the LaGuardia stage station and the last recorded entry read less than 500 ft. on the approach (AW Mar. 23, p. 39).

W. G. Benscheder, former chief of the Mechanical Instrument Section, National Bureau of Standards, and consultant to Kolloman, listed the following causes of possible altimeter error as Lockheed Electra N6021:

- Static deflection in the pressure sensitive elements may permanently and temporarily cause a drift in reading. Benscheder stated that these deflections will not exceed 40 ft at 50 ft.
- Leaky diaphragms capable could cause an error of 1000 ft. However, tests made on the recovered instruments indicated no such leakage.
- Friction caused by misalignment and small imperfections in the gear teeth will cause beatings of the pointer. Friction is usually minimized by lubrication.

Canadian Bilateral

Washington—Bilateral code of practice of the bilateral agreement between the U.S. and Canada is now expected by observers to have deeply increased negotiations to complete an agreement on air transport of passengers.

Representatives of both countries now believe that further studies of routes to meet the two countries' air traffic control needs will be required as a result of the proposed code of practice, which can be included or ignored, particularly at night," Tweddle said.

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Memorandum Asked

Washington—Capital Airlines is seeking a memorandum on debts due that year totaling more than \$17 million, according to the company's annual report filed yesterday last week.

Financials as stated in 1959 amounted to \$12.2 million and one on debts totaling \$1.1 million which were due 1959 but were not paid will be deferred at negotiations with American. American now is progress in negotiations. Both engaged in discussions at the Viscount meeting, 275 passengers and to date, the carrier has made payments on the notes of \$1.5 million.

Notes, which are secured by a chattel mortgage loan on aircraft rate of 11% in excess of the Bank of England rate will not exceed 60%. Under the proposed amendment to the chattel mortgage covering the memorandum on debts due in 1959, a reduction will be placed upon the notes that will prevent the purchase of new aircraft in the listing of aircraft without approval of the shareholders.

Investigation, Benscheder noted, but he added that such is an unusual instrument, 500 ft. errors are unlikely.

- Shock damage could cause some damage to the altimeter. There is however, no evidence that the instruments suffered damage due to turbulence.
- Error from sources, including human error, such as reading, writing set ring, etc., and errors due to vibration. The shock damage may be reduced by 500 ft. or more.

• Error from sources, including human error, such as reading, writing set ring, etc., and errors due to vibration. The shock damage may be reduced by 500 ft. or more.

American Route Bid Opposed by United

Washington—Clyattine protesters that jet speeds will force a new group of only major to cross business routes were not questioned but such by United Air Lines in the New York Sun.

Wiley Thompson, president of the airline, told the Great Air Transport Board in Denver, who recommended American Airlines for operating authority between the two cities, that United had made a "new type of move," such as New York, businessmen who will be able to make a round trip flight to San Francisco in one day.

United replied that development of a travel agency task as that is not supported by sufficient evidence, and said that jet would top flight times will not exceed 10 hr. with an additional four hours of ground travel time, having little time for any business transactions.

Port Authority Noise Investigators Criticize American's Jet Takeoffs

By Gene Gorham

New York—Port of New York Authority has complained that American Airlines "is not doing its share" in the jet noise reduction program at New York International Airport.

Following the results of monitoring 812 jet takeoffs during the four-month period ending Feb. 28, the Port Authority advised that airlines operating jets at Idlewild that all but 53 of the flights conformed with more restrictive procedures. Overall, most of National Airlines, Pan American World Airways and British Overseas Airways Corp. was 65% non-conforming, the Port Authority said.

But American failed to conform in 48 takeoffs out of 182, for a record of 27% non-conforming performance, the agency charged.

The noise reduction procedures, calling for special jet noise protection and climb and turn regulations, were the basis for the Port Authority's acceptance of jets at the airport. The acceptance followed long negotiations on the Port Authority's part to let the jets at that present noise level into Idlewild at all. The controversy was finally compromised when Pan American's use of noise-reducing jets 707-120s won the airport a 10-day test ban waiver (AW, Jan. 27, p. 70).

Pan American, however, has not been happy with the process, which has been slow and has had the effect of hurting airline earnings and reducing savings opportunities in Europe.

In letters to the four airlines earlier this month, Port Authority Director of Aviation James Wiley reported that 93.5% of the 812 jet takeoffs (which exclude training flights) had been noise-free since Jan. 25 in during the four-month period. Climbs out from these aircraft is over water and there are the time periods.

Wiley says BOAC and Pan 116 takeoffs, with only five non-conforming. Los Angeles-American Airlines has experienced "practically no trouble" with the performance of its Boeing 727-120 and Lockheed Electra turboprop aircraft, according to M. G. Beard, assistant vice president, equipment research.

Most unusual problem with the airline's new jets and turboprops, which went into scheduled service in January, have been electrical and electronic and in the airplane's systems, Beard reported at an Institute of Aviation Sciences meeting here.

Each aircraft of the Douglas DC-8 and DC-7 piston planes, on the other hand, had been hampered by engine

"We know you will be pleased, as we were, by this evidence of (your) cooperation and genuine concern for the welfare of the airport's neighbors," Wiley wrote National, Pan Am and BOAC.

poseplane and aircraft bags, Beard said.

The American Airlines' official said it was too early to come up with statistics on the turboprop operations, which have been restricted to two of the 118 aircraft. He added, "New York, Boston and Los Angeles are the present top five between New York and Chicago and five between New York and Boston jet flights via Chicago."

But he cited some problems of each operation, including difficulties in obtaining spare parts. In some instances Beard said, component vendors had stopped manufacturing certain parts, forcing modifications. It was necessary to get the old part back into limited production. It had been difficult to anticipate exactly which components to stock at various stations, Beard added.

These problems are now being ironed out, he said. The New York and Milwaukee parts of the redesign to accommodate the new aircraft are now ready.

American's pilots reported about 20% of flight training time was on the northern stretch at the start. Beard and Flight director aware and maintenance approaches to engine-specific operational, extraction to your flight personnel."

Wiley also emphasized the hope that the acceptable ground in the rear of the aircraft will be modified towards the nose problem on the part of other voice pilots as route management, and that steps will be taken promptly to upgrade conditions by route-specific operational, extraction to your flight personnel."

Wiley concluded his letter to Meader with a plea for American's cooperation with airport neighbors, either get or leave and the Port Authority "in person serve the spirit to enable attitude of airport communities toward the jets of the future."

American will reply to Wiley when the airline has completed redesign of the aircraft and has 40 jet takeoffs, a spokesman told Aviation Week. That will be completed within a few days he said. American's policy is one of cooperation with the airport's neighbors, but operating safety is above the first consideration, according to the airline.

American Has Little Turbine Difficulty

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Convair Rolls Out Third 880 Jet Transport

Third Convair 880 jet transport (right) rolls out at San Diego plant of Convair Division of General Dynamics Corp. Far left (left) was preparing to take off on its 20th flight. Second Convair 880 is undergoing ground load tests at Convair Maintenance Laboratory. Third ship is the first to be equipped with jet engine sound suppression.

Banker Sees Potential Jet Cash Harvest

New York—Airline jet financing has been moved out on a consecutive basis that will enable the carriers to exploit their experience to step a potentially beautiful cash harvest in the 1980s. T. Carl Wendl, a First National City Bank president, told a Wings Club luncheon here:

Wendl was optimistic that the new bank would make a great deal of difference. Lenders will recognize the needs of airlines to keep competitive in equipment, Wendl said. Despite his concern that the experience step would not enter "prematurely," he said he predicted it would be here before an one expected "a" will follow 1975."

One point Wendl stressed as a good sign was the relatively new aircraft market, which is taking off despite the fact that financing numbers have been relatively low since 1974. A potential lead, he said, is the 1974-75 Suez Canalization of \$2 billion invested in U. S. Treasury bills. To the extent that each proceeds from sales of its long-term bonds goes to investment in airlines' cash flow projections to the same extent that can be realized, "as noted at a recent lecture in the success of the airline's financing of the jet," he said.

Wendl said the airlines, with a few exceptions, had successfully maintained their existence into the jet age (AW, Dec. 35 p. 37). He broke down the financing picture in this fashion:

• Total amount that will be available probably will be in the \$1.4 billion range. Total long-term debt holder of airlines probably is under \$500 million (though an all-time peak, for example). Their combined book net worth was slightly under \$500 million at year

end. That leaves, as effect, four apiece to live airlines something under \$1.10 for every \$1 in book value. To actually recover the full amount of the investment, the airline must increase their present equity ratios—either through purchase of additional stock or from related earnings.

Minimum Requirements

Furthermore, he set certain minimum requirements for working capital when the new aircraft are taken into service. These include a minimum of used planes equivalent to "Gone by the Date," he said, when even DC-7 and Super Constellation the replacement of \$2 billion invested in U. S. Treasury bills.

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Code Type A18112 Connector developed for a major airframe manufacturer. Makes 100 connections using 30 amp. Code Self-Aligning pair, 5,000 volts RMS. Nylon insulators have quick-acting break-away lugs and positive lock. Insertion pressure for 100 pairs is only 11 lbf, withdrawal, 15 lbf. Tested to 40 Gs. Measures only 4" x 4".

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balance of about \$230 million, not including perhaps another \$100 million in depreciation for tools other than flight equipment. In 1975 total depreciation was \$200 million and total cash generation was \$210 million. Thus the jet fleet cash break even, the ~~airlines~~ cash generation will exceed debt amortization by over \$100 million a year.

*Earnings projections, using a new estimate called "cash generation per available seat mile," indicate future net cash generation of \$340 million annually. This figure is obtained using a cash generation per available seat mile for current public transit service of 4.5 cents of a cent and a total available annual seat mile figure for the 1980s of \$8 billion.

Depreciation charges should not be as high as \$360 million and thus substantial savings are possible. Assuming the air lines would have \$100 million a year cash flow after covering debt maturities in 1961 through 1965 there would be over \$500 million available for additional jet purchases.

"With a little bit of average luck," Wedel said, "the book net worth of the authors by 1965 should be well in excess of \$1 billion, without taking substantial additional equity. If the initial years of the jet age prove at all financially and monetarily successful, there is no

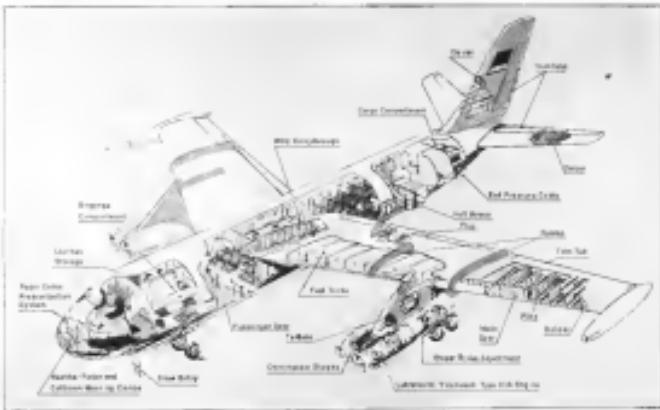
tion to ensure that London would not again be willing to consider at least working slides for dollar the admits—so the potential for borrowing additional funds should definitely exist in the 1960s."

Index Restricted

For the moment, just one dramatic loan repayment and virtually all foreign loan agreements in the U.S. are suspended. The U.S. has not yet taken any other broad-based or any other major step in negotiations. *Wolff* said, "but unless you ask the participants whether or not future purchasing people have had to radio, later with their financial records—unless that changes the negotiation quality."

Britain Reaffirms KLM Flight Limit
London-British government has re-

British demand not to allow KLM to use the airport, and the British finally bought the airport at Singapore after the end of that month. Britain sold Holland in January 1939, (p. 47) that KLM must cut its weekly flights to Singapore to once a week. The last flight of KLM to Singapore on 15 January 1939 was piloted by Captain G. W. G. van der Linde, also the Dutch pilot who



BB-152 Cutaway Shows Transport's Detail

East German pilot's drawing of prototype MiG-15 pt. bis/sep. shows same loading for aerofoils from belly to under engine pods. Twin landing pod configuration also a change from prototype configuration (AW Mar. 19, p. 56).



GENERAL ELECTRIC T58 MEANS...

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Twin General Electric T58 engines
Give Sikorsky HSS-2 Increased Per-
formance, Cruising Speed and Endurance

Sikorsky's HSS-2—newest Navy ASW helicopter weapons system—will rely on the proven performance and reliability of its twin General Electric T58 engines to get it to the search area faster—keep it longer—and get it home faster.

The T58's reliability has been proven by more than two years of flight test flying on a modified HSS-1. As a result of this unmatched twin-turbine flight experience, here's the kind of engine response the HSS-2 will get whenever it demands the large load changes required on ASW missions:

RAPID POWER RESPONSE

T58's load
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EXCELLENT CONTROL STABILITY

Flight tests have confirmed the stability of the T58 and its ability to adapt to the dynamics of the helicopter rotor system.

EFFECTIVE LOAD-SHARING

Two and one-half T58 installations have demonstrated load-shifting capability in all types of operating conditions—their ability to satisfactorily maintain load division between engines.

This proves no flight reliability is only part of the T58 story. Results of the T58's 150-hour Model Test reflect the engine's high power-to-weight ratio and

LOW SPECIFIC FUEL CONSUMPTION

OUTPUT GUARANTEES EXCEEDED BY 70 MPH

T58-6 produced as high as 13.89
shp per pound of thrust.

T5C GUARANTEES FETTERED BY 4%

Contracted at 0.66 lb/hour... T5C was recorded at 0.61.

15 LBS LIGHTER THAN SPECIFICATION

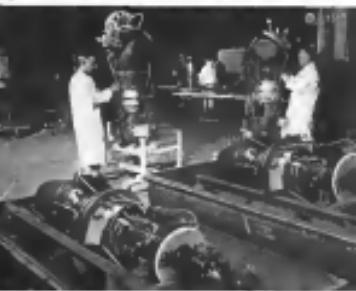
T58-6 weighed just 156 pounds, compared to specification of 171 pounds.

Add the outstanding performance to the T58's demonstrated reliability, and you see why the HSS-2 is expected to be the Navy's number 1 subhunting helicopter.

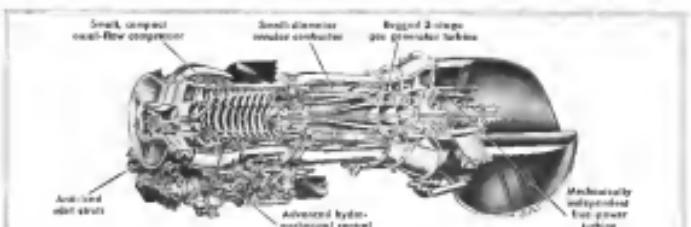
For the latest T58 progress report, write to General Electric Co., Section GED-388, Schenectady, N. Y.



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GENERAL ELECTRIC

AIRLINE OBSERVER

► Increasing rates for turbine transports pose the threat of a new cost factor for airlines. Rates for turboprop transports or for the Lockheed Electra has not yet been finally settled, but are now being quoted at 15% to three times rates now. Airline companies, which have based current rates on what rates are available from manufacturer's test operations, military experiments and foreign operation, will probably recompute their rate structure as a year to base them on actual economic experience. Rates could go up or down there—in a revision might be sought as soon as an analysis of current operating experience is drastically different from projections by manufacturer companies.

► Federal Aviation Agency Administrator Edward Quarns is a letter addressed to all scheduled and non-scheduled airlines, for called for some point vigilance in terms of reducing the maximum load. Quarns notes that "It has been my personal experience... that too often the pilot is back in the cabin talking to passengers...," and adds "The practice must come forthwith."

► Continental Air Lines' expenses with the Vickers Viscount 800 now lead the way to conservative on-holding component in its long range planning. Board is making a strong sales pitch to Continental with the turboprop Britannia. Pan American 707-200s are due for delivery in 1970, but the airline expects only 15 Viscounts will suffice for 40% of all air cargo operations during the year. During the last seven months of 1968, Continental flew in Wisconsin at a cost of 1.07 cents per tonnable ton-mile, based on cost of aircraft operated by the airline. The company also expects that it is the first major airline to have sold off all its major prime-engine equipment.

► Pan American is planning a proving flight to Bangkok later with a Boeing 707-123 turboprop transport as a first move toward fitting a South American schedule into its service jet pattern. Outcome of flight will determine final scheduling plan for the service. Uncertainties include airport, navigation and other operational problems in Latin America. Next month, Pan American will increase jet flights to London to two a day. More service to Rome and Paris will follow. However, methods in the Europeans will not be necessary when PanAm's Latin American service begins (AW Mar 23, p. 45).

► Countries are strong that an equitable fare level for South American routes will be reached at the earliest convenience now as soon as Latin American (AW Mar 16 p. 36) Reasons for the optimistic pattern. South American carriers that have offered service at higher rates and higher revenues to major European lines. In addition, airfares using standard fares are willing to allow "undeveloped countries" to charge fares at a rate 10% less than established fares.

► One of Aeroflot's major objectives under the new Russian seven-year plan is to have turboprop and turboprop transports account for 95% of all ton-miles flown in 1985. Officials of the Soviet airline say the "high productivity" of such planes as the An-104 and the four-engine B-18 and Tu-114 makes this goal feasible. Aeroflot fits the Tu-104 as "seven times" more productive than the piston-powered B-18, the B-18 as "eight times" more productive, and the Tu-114 as "30 times" more productive.

► Trans Air Express will begin Lockheed Electra service July 1 between Houston, Dallas and Chicago and between San Antonio, Dallas and New York. Service with the Boeing 707-120 will begin over the same routes on Dec. 1.

► Need for two more types of turbine-powered transports still exists in the airline field, according to William Littlewood, American Airlines' vice president. In his address to the Washington Am. Club, Littlewood called for a new generation of transports, high and rapidly enough to cover medium-range, heavy density traffic markets. For lower air travel markets, or local service markets, Littlewood wants a short-range, low-torque turbine aircraft with a seating capacity that will exceed economic load factors.

SHORTLINES

► British Overseas Airways Corp. plans three nonstop Bristol Britannia flights weekly to London in its nonstop schedule of operations to the Orient. The nonstop flights, leaving from Detroit's Metropolitan Airport on Mondays, Wednesdays and Thursdays, will be handled by two flights weekly stopping at Shangha, and another two landing at Peking and Canton before terminating in London. All seven flights will operate, in first, tourist and economy classes.

► Flying Tiger Line reports a new company record in air freight revenue for the month of February with \$1,089,394 earned, a 72.4% increase over February, 1968. Volume of traffic for the 12th consecutive month of 1969 is reported to be 44.4% higher than that for the same period last year.

► International Air Transport Assoc. clearing house in London reports that more than \$82,000,000 in international air cargo business was settled through its offices last year, a 23% gain over 1968 business. IATA has total turnover during the twelve-year history of the clearing facility is \$354,00,000,000.

► Lockheed Aircraft Service, Inc. has received orders for 50 flight recorder units from Trans World Airlines, Braniff International, Delta Air Lines and Canadian Air Lines. TWA already has delivered flight recorders to Pan American and American Airlines.

► National, Northeast and Eastern have filed briefs with the Civil Aeronautics Board for a 25% fare reduction on night coach flights between northern cities and eastern United points. The fare last applicable on Monday, Tuesday and Wednesday nights, would be \$37.49. The Board has reported that it accepted the original National filing on March 30 for reclarified actions only.

► Pan American World Airways reported 103,004,000 ton-miles of cargo during 1968, a 5% increase over 1967 on a world wide basis and 12.5% increase on the transatlantic routes.

► Western Air Lines reports a net income of \$1,402,340 or \$1.31 per share in \$22,620 shares outstanding for 1968. Western's operating revenues for the year were \$31,973,204, down 19.4%, operating expenses were \$31,918,349, up 11.9% over 1967. The operator's net gain from disposal of property amounted to \$1,522,386. Net operating loss was \$120,046, reflecting Western's 108-day strike in 1968 by the Am. Line Pilots' Assn.

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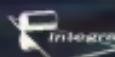
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SUBMARINE SHELLS SOUTHLAND OIL FIELD

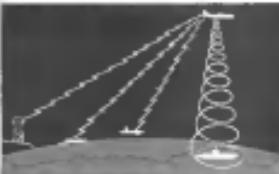
An almost forgotten incident of World War II occurred when an enemy submarine shelled a Southern California oil field with its deck guns—then escaped to sea.



IN 1942, only a few thousand people lived within range of that enemy sub's deck guns. Today, from that same offshore location, an enemy sub could launch long-range cruise missiles to devastate targets in any place in our 17 westernmost

states (population 40,000,000). To negate the growing submarine threat, the U. S. Navy has developed the world's largest, most efficient anti-submarine warfare force. For 34 years Lockheed P-3V land-based patrol planes have been

the backbone of that program. Lockheed has more experience and training facilities for producing ASW planes than any other company. That's why Lockheed can build better ASW planes—in less time, for fewer defense dollars.



WORLD'S MOST EFFICIENT AND DURABLE sub hunter-killer plane—a direct design descendant of performance-proven ELECTRA—P-3V-1 is being developed for the U. S. Navy.

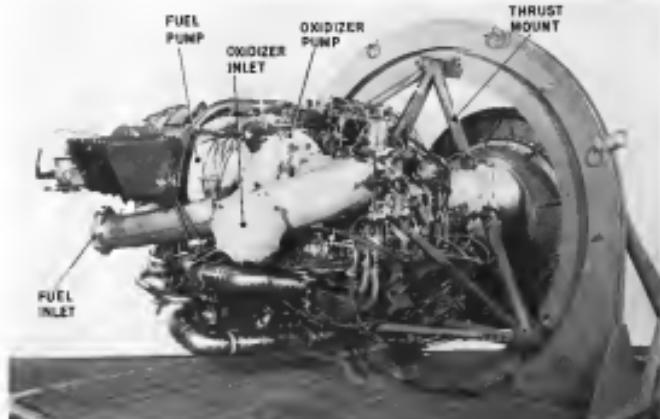
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SPACE TECHNOLOGY



FUEL and oxidizer enter from propellant from external tanks. These are the sole propellant components and are ignited with the compact engine package. Engine diameter about 8 ft. by 31 ft. and is designated RMD-XLR99-RM1

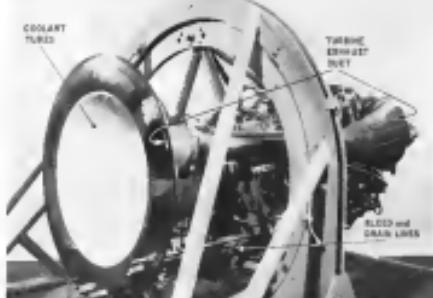
X-15 Engine Will Have Wide Space Use

By Michael Yager

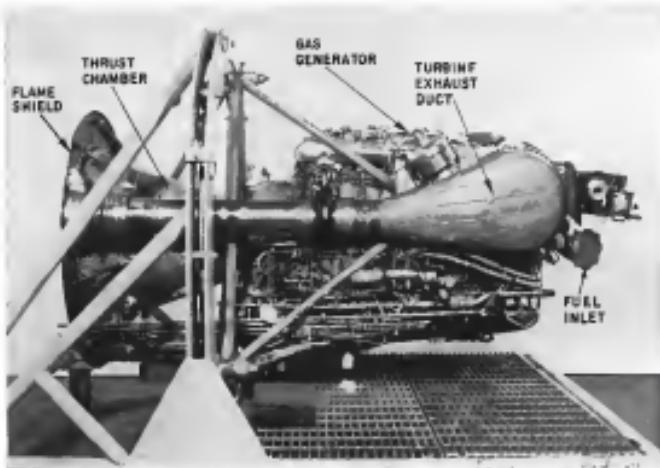
Douglas, N. J.—Reaction Motors Division of Thiokol Chemical Corp. will make low-cost engines for the first six flights of the XLR99-RM1 2-stage engine to be used on the first flight of America's X-15 hypersonic research aircraft. First flight tests of the new engine will take place during the fall.

Meanwhile, the two RMD-XLR99 solid rocket engines now in the X-15 will be used in the initial powered flights of the aircraft. These engines, first used in the X-1 and D-518-II programs, are quoted only in mass specifications of valves and propellant lines. An X-15 planning to accommodate them. Substitution of the single XLR99 for the two XLR99s is considered a simple matter as no attempt is made to reuse either.

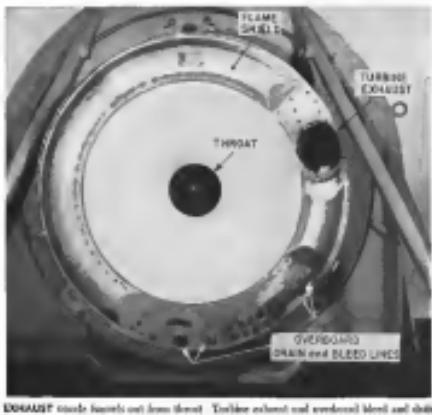
With small changes Reaction Motors says, the XLR99 can be adapted to other aerospace space program applications, both terrestrial and orbital. The company already has completed several proposals in this effort. A leading potential candidate



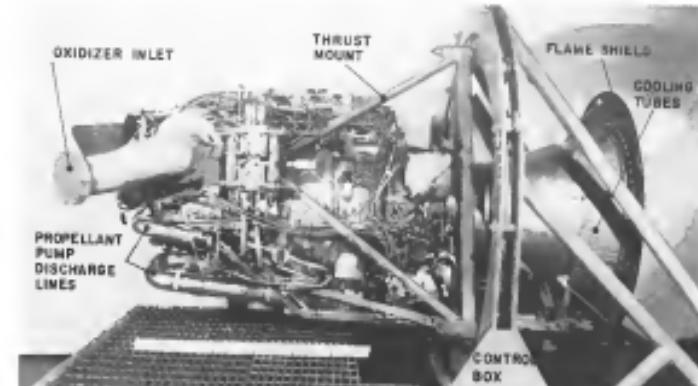
COOLANT tubes can be distinguished in shaded lining of exhaust nozzle.凉却水は、熱を逃すためのノズルの内側に塗られた。涼却水は、熱を逃すためのノズルの内側に塗られた。



ENGINE thrust mount (arrow) looks to exhaust through these attachment points. Flame shield also is bolted to mount. Heavy bus and control frame are part of the mount, not the engine. Control tubes which form thrust chamber will run to stern ahead of flame shield.



EXHAUST nozzle looks out from throat. Turbine exhaust and overboard drain and bleed lines are turned back from front of engine and brought out through the flame shield.



CONTROL box reportedly monitors XLR39-RM1 engine operation. Below, X-15 is carried aloft by Boeing B-52 mother ship.



for the engine, in the company's view of the Dual Star upgrade, number. Other possible applications include upper stages for the Saturn, Centaur and other air-cryogenic vehicles with a liquid propellant upper stage. (AW Mar 2, 1974, p. 39)

At 6 tons, the XLR39-RM1 will burn a combination of liquid oxygen and liquid ammonia but it can be converted to high energy fuels on earth, according to Reaction Motors. Removal of the quartz nozzle, for example, would probably be the most important modification required to set the engine in a variety of hypersonic propellants.

Operational Highlights

In the case of liquid hydrogen, the fuel pump now utilized for the liquid ammonia would have to be replaced with a pump of greater speed and larger diameter fuel passages. Among the other design and operational highlights of the XLR39-RM1 are the following:

- Maximum throat of the engine is over 16,000 ft with a nozzle that has an area of more than 10,000 ft²/min. Helium will be used as a tank pressurizer and purge gas and the turbine

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pump will be driven by gas, evolving from the decomposition of hydrogen peroxide.

• Thrust rating of XLR89-RM1 is greater than that of any other single chamber rocket engine of comparable size. Again not in propellant subsystem, the variable thrust of the XLR89-RM1 makes it less sensitive to fuel change than a fixed thrust rocket engine like those now in existent missile.

• Growth potential for higher thrust has been built into the engine. Engine uses designed the combustion chamber large enough to permit operating at the thrust area, should some time in the future be desired at a little more.

• Fabrication of engine is similar to that of Redstone. This and booster engine (AWP U-2) are similar in that they have similar basic tubes, shaped with varying cross sectioned dimensions along their length, are heat and length directly mounted to form the thrust chamber. Liquid ammonia is circulated through the tubes (which now form the chamber wall) for cooling.

• Startup of the engine is based with a new non-explosive igniter, rotating barndale and auto in itself starts engine. Neither the thrust nor the effect part of engine has to be replaced for a number of ignitors.

Firing Operation

Exact operational life of the XLR89-RM1 has not been officially announced but is said to be comparable to that of the smaller rocket engine used in the Bell X-2 research aircraft. Duration of any single firing is limited by the use of the propellant tank that can be caused in the X-15.

• Firing condition which has been built in as a reliability feature permits engine startup procedure to be carried to point of firing thrust chamber and then stopped in case something has gone wrong. At that point, 90% of the operational functions have been placed in a fail-safe mode. In other words, shutdowns are such that all have occurred before fire point is reached.

Single combustion nozzle which governs the development of the XLR89-RM1 allows any one component in the engine, such as a shock, to fail at any time without leading to a hazardous condition that could damage the vehicle.

Restoring of the engine in flight is somewhat involved but can be accomplished in approximately 10 sec. First the engine is shut down and closed at residual propellent from the propellant valve back through the combustion chamber, using helium. The ignition system is usually paged. All self-ignition detection devices are required to "start" position. Fuel and oxidizer supply is checked along with available

propellant for the pump turbine. Propellant lines are checked to there is no separation of the propellent in the propellant elements. Ignition system is checked to make sure that the supply of electrical, hydrazine and propellant power needed to restart the engine is adequate. If every element is "safe," the engine will then restart.

Sealing Devices

Sealing devices are provided to keep the pilot informed of engine operation. These include the following: a gauge to record the pressure in the combustion chamber and throat nozzles, a pressure gauge for each of the two propellant pumps for check of pump system and fuel system; a pilot reading during after combustion; light to indicate shutdown function of the ignition system, having an off position and to tell pilot if he has been born that there because of a malfunction.

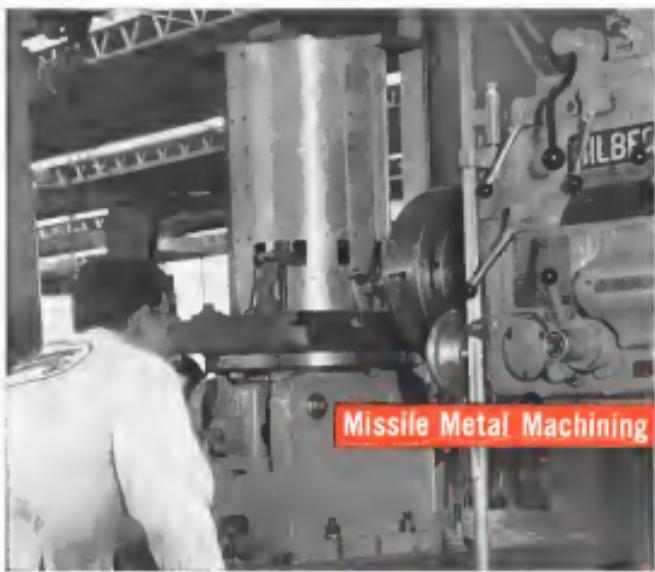
Engine operation is almost completely automatic in the XLR89-RM1. The pilot selects thrust level he wants, and pushes the throttle to the selected position. The engine goes through the ignition pattern and takes over the responsibility for all own operation, except for adjustments in thrust level which the pilot makes. If in his judgment, the engine seems to control, he has the option of trying to override the automatic controls. If the engine starts then does not have a failure in the combustion, the pilot can fire it again at will. If the shutdown is accurate and precise, the automatic controls will prevent a restart.

Integrated design of the XLR89-RM1 has gathered all propellant components except propellant tank into one compact package about the thrust chamber.

Engine Development

There are two in development. The XLR89-RM1 is the most powerful and most reliable rocket engine ever built for guided missile. Prepared in 1964 is the Super Viking which Reaction Motors had developed for the Super Viking sounding rocket (which was never built), the present engine being very little modification to the original. Its development, in fact, sharpens up the design disadvantages between the design of a rocket engine for a predetermined, one-shot missile application and a soft, throttling, reusable power plant for manned vehicles.

In going from the Super Viking to give to the XLR89-RM1, Diversey had to meet considerable problems, not the requirement for "planned safety" in construction and specification S-N-5749 and ANA Bulletin 424. The need was dictated repeatedly by the Air Force



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Mechta's Trip Past Moon May Have Been

By W. A. Doley
and D. H. Reiley

On Jan. 28, 1959, the Soviet Union successfully launched a solar satellite. Soviet scientists have given it the name "Mechta," meaning "hope." Unfortunately they have not indicated the purpose of the launching, nor have they released much data.

In spite of this, the idea has been advanced that the objective was to achieve a hard impact, and that the mission was unsuccessful because of an excess of fuel.

However, from the small amount of information available, a strong argument can be presented against this and in favor of a heliocentric satellite, where the excess velocity is actually needed.

Furthermore, because of the large period of 180 days, it is believed that instrumentation is on board which can be turned on or off as well from the earth. Therefore, continue to the popular idea that the batteries are dead because there is no longer a power source. It is suggested that they are being used for attitude control.

The probe was launched on the day when the earth was at perihelion and at such a time as to take full advantage of both the earth's velocity and the moon's position in space. When it perihelion, the earth is moving about 3,280 fps faster than an aphelion. Although the potential energy at a maximum, a probe fired during this period, in the direction of the earth's velocity vector will travel farther from the sun than if it is fired under similar conditions of aphelion.

Kinetic Energy

This can be explained by noting that the additional kinetic energy added to an object by a fixed increment in velocity is a function of its initial velocity. The faster the object is moving the greater the energy savings. In fact it can be shown that the aphelion distance of the probe, when fired at the earth's perihelion, is 3.463% greater than when fired at the earth's aphelion. This is independent of the heliocentric excess velocity because, the probe would reach at radius, neglecting solar influence, possibly if it is small compared to the earth's velocity and about the two bodies perihelion.

The additional energy to the heliocentric figure of 57 is based on the Klemm-Kruger data listed in Table II. If the sun is approximately correct then the probe probably entered heliocentric space with a velocity of about 105,540 fps (with respect to the sun), which causes

approximately to a hyperbolic excess velocity of 6,877 fps. The hyperbolic velocity of the launch vehicle is the square root of the sum of the squares of the heliocentric excess velocity and the escape velocity at the launch altitude.

Assuming a launch velocity of 100 km/s, which appears reasonable for such a probe, and about 16,500 (ps) this is about 2000 ps greater than actually needed to escape. This does not necessarily mean recent thrust at the moon would be required in any case. That is, it is possible to be impacted by the moon, short of collision, without using retrograde, regardless of the orbital conditions in heliocentric space.

The reason does not appear to have given the probe a significant boost in velocity since the orbit approach would have been established without it. A small boost may have occurred, however. The vehicle's direction could have changed some also. It has been reported that the vehicle automatically entered its orbit after passing the moon. This would imply that launch parameters were not desired although this claim does enable a sensible data to be collected.

However, although these velocity increments are important for interplanetary operations, they have little or no significance for a hard shot. It is then found easily certain that the following

Mechta's Purpose

W. A. Doley, senior design engineer, and D. H. Reiley, design specialist at Convair's Astronautics Division, have made a study of Soviet Russia's launching of the solar satellite Mechta. They believe that it may have been the first probe to a sunspot leading to a short at Venus this year or to Mars in the fall of 1960.

In view of the large payload launch time, excess velocity and trajectory, Doley and Reiley conclude that a heliocentric orbit probably was a good policy for the result of a cancellation, and that Mechta may be part of a program to determine the Astronomical Unit with greater accuracy. Mechta was fired when the earth was at perihelion. If another aphelion were July 3, and the surface report that another long day may be made then.

They have analyzed the period with respect to power requirements for transmission over distances in great to 25 million miles, and made weight estimates. In the belief that Mechta might have transmitted later than the 62 hr listed suggested by Soviet measurements,

three objectives which might have been achieved can be discounted: (1) lunar impact, (2) lunar reconnaissance, and (3) lunaruttle.

There are two other objectives which appear to be entirely feasible: (4) a heliocentric stability using the moon as a vantage point, and (5) lunar photographe, and with possible physical measurements.

The fourth objective was achieved, as is well known. Some of the consequences are presented below. The fifth objective may have been achieved and will be discussed briefly.

From what has been said it appears that the primary function of Mechta can be to give the way for interplanetary exploration. According to Oerlikon, launching opportunities occur about every 24 months for a Mariner probe, the next favorable time being in September-October 1960. The Soviet Union may plan to launch a probe at the time other than that until the end of 1962.

However, at the present time, the orbital parameters and the distance are known with the present record to determine the final flight, called a close flyby in heliocentric space. The more elliptic orbit around the sun, the uncertainty in the computed value of the Astronomical Unit—the sun's distance between the earth and the sun. The Astronomical Unit is used as the basic yardstick for measuring relative distances between the planets and selected bodies, but it has not been calibrated in terms of heliocentric standards of length. It is known to four significant figures at least, or at most. Thus, at the present time, the sun's orbit is determined by the earth and the sun to a length of about 35 earth radii.

Furthermore, the uncertainty in the Astronomical Unit is a neglectable as possible for a margin in the required solar velocity for interplanetary trajectories of short ps or about 33 fps. The significance of this error on predicting the error has been determined. For both orbital displacement and flight time errors.

Fest Transfer

For example, consider the last transfer orbit to Mars, shown in the top figure at right. The flight time is of the order of 250 days for a launching in the fall of 1960. The computed orbital displacement is of the order of 90,000 miles, or for a heliocentric departure time of 33 fps. This is in addition to the possible earth error. But the corresponding flight time

is 1000 miles.

Intentional

error is much more accurate. An error in arrival time of plus or minus 0.4 hr for each 100 ps second error in distance is determined. The test error in arrival time is therefore about 1.3 hr. This corresponds to a displacement of Mars along its orbit of about 0.6 million mi. from the probe.

These calculations are intended to show importance of a solar probe de-traversing of the Astronomical Unit.

It is therefore suggested that the basic mission of Mechta is to help accomplish this measurement. If this reasoning is correct then the final more accurate should be made by mid 1963.

Interplanetary Probe

A probe launched at the earth's perihelion requires one criterion for the determination of that quantity, i.e., the minimum value of the craft's distance from the sun. The other extreme, or aphelion, takes place on July 3, 1973, at which time it might be logical to launch another probe. Several additional probes might also be referred to the interior.

When an aphelion point, a cloud of sodium vapor was released from Mechta. From it is appears that a working mechanism has been found to operate sodium vapor probably to reheat from the earth. Since a cloud of sodium gas that is an efficient ion source could be an efficient ion source collector in the presence of direct sunlight, it could be used to locate the vehicle against the star background. If the position of Mechta is known accurately in its orbit, a high powered radio source with a long focal length could be used to determine the direction to within a minute or less.

This implies, of course, that a small radio source, which requires construction, must be carried along as part of the probe's instrumentation. However, a total of 100 ps could be made to operate for months with a total weight, including batteries and solar cells, of a few pounds. Similarly, the electrical energy required for releasing sodium can be supplied with a small battery over and over again. Very little storage would be required—just a few grams for the entire mission.

The Doppler shift expected of the sodium D-line is not enough to make a worthwhile measurement of radial or local.

However, the frequency shift of a 1000 ps source can be measured to a fraction of a cycle, possibly to 0.01 cps. Also, velocity-biased oscillations are now available which are held constant in frequency to one part in 10 billion to one trillion. Thus the possibility of measuring velocities with an accuracy of



FIG. 2 TYPICAL TRAJECTORIES for Mariner probes in the fall of 1960 are illustrated above. One represents a minimum energy condition which takes about 250 days. The other, at a later date, is a feasible low trajectory, obtainable with present systems which take about 110 days. During low trajectory the probe is held beyond heliocentric space. The probe is shown retiring a heliocentric orbit on Jan. 28, 1959, which includes the perihelion part of the trajectory. Total travel is reflected on Jan. 2, 1970, the day that the earth was at perihelion. Thus, during these 113 days the earth has passed through 33 million mi. and Mechta through 32 million mi.



—WALTER H. ALEXANDER & ROBERT H. REILEY

ground-level escape!



T-2J gets first successful rocket-catalyzed ground-level escape system

Nearly 90 percent of aircraft emergencies occur below 1,000 feet—primarily during landing, take-off.

That is why the Columbus Division of North American Aviation, designer and leader of the Navy's T-2J jet trainer, has developed and successfully tested a new ejection system that is ready effective on the ground and in the air—at stall speeds and jet speeds.

North American's new Emergency Escape System uses a rocket-catalyzed to hurl the man high above the ground—yet with maximum "G" forces on the pilot. The ejection sequence is completely automatic. Timing devices are used for optimum drag chute deployment.

High rate-eject separation, and parachute opening

North American's system is not only much safer than present operational systems but also much simpler and more reliable. It is the first of this type to be accepted by the U.S. Navy as a standard system for use by Navy trainees. And North American is making it available to all aircraft manufacturers as part of an entry-wide drive to raise the safety of America's pilots.

The Navy's A-4 Vigilante—today's most versatile attack weapon system—will have a similar escape system, modified to provide optimum ejection at atmospheric altitudes.

THE COLUMBUS DIVISION OF NORTH AMERICAN AVIATION, INC.

Columbus, Ohio



Table III
Estimated System Weights

	lb
Complete ejection package for re-entering, landing, ejection	52
Stowage container	30
One foot parachute assembly	40
Guided missile	70
20 ft. drogue	31
Precision ejection computer	20
Battery pack	26
Gas cylinder	1
Gas trailer	1
Star trailer	1
Spine wheels	1
Digital computer	1
Sync system	1
Total payload	162 lb

During flight, by using the telescope can be made to point at the center of the sun (i.e., in azimuth and elevation). A similar arrangement was used recently by Schwassfeld and Rygdon of the Princeton University Observatory for photographing the sun during a balloon at 56,000 ft.

Since the telescope center is in the ecliptic plane, a 160 deg. search in the sun's plane and about 10 degrees about the sun's plane should be adequate. Once the sun is acquired it is not difficult to keep it in a single field since, over their relative positions are well known.

When the tracking system has found both the sun and the star, a parallax circle can be calculated to form a reference frame within the vehicle. This enables it to point the antenna in any desired direction. Although the relative position of the earth is changing it is known as a function of time.

The power requirement for attitude stabilization is of the order of 100 w. during acquisition.

The required torque for correction can be provided by a simple pyramidal Spain wheel which can also be used as a reaction wheel. Thrust control hydrazine could be used at launch to tilt the attitude in space but it would interfere with almost every other system such as starfinding, for example.

Low weight digital computers are available which are capable of carrying out the above functions. Once these functions have been programmed, and the weight and power estimates made, it is possible to estimate the minimum size capability.

The 12 deg. beamwidth (Table III) of the tracking antenna will cover the entire earth over the pole to a 1000 ft. horizontal radius out. The ground-based antenna is assumed to be 100 ft. in diameter, which certainly

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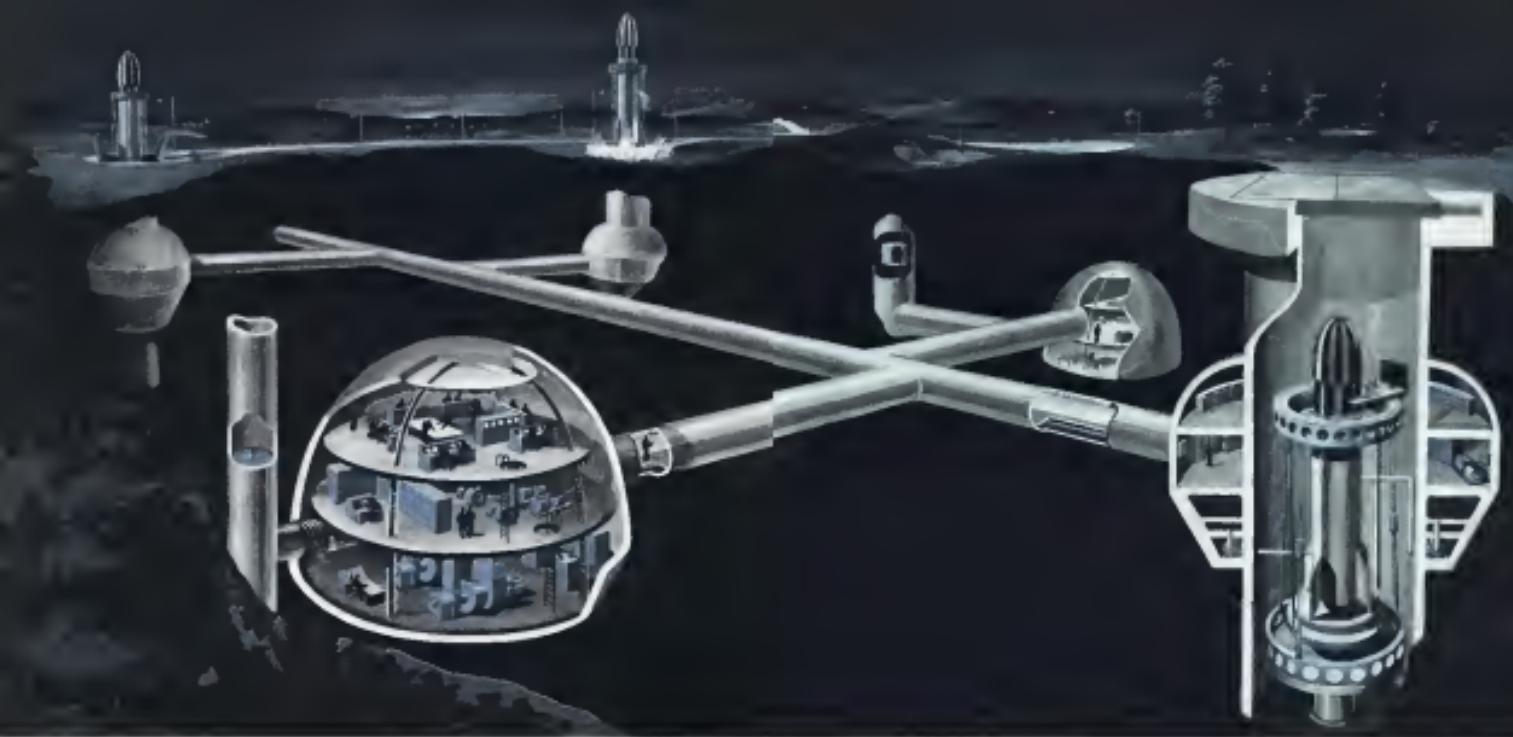
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Artist's conception of a possible hardened missile site, showing in block some of the specialized equipment which Westinghouse can supply.

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The mounting system shown here was designed, developed and produced by Lear for the inertial guidance platform of an AGM-65. It clearly demonstrates Lear's capability to meet the most sophisticated requirements for shock and vibration protection.

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AERONAUTICAL ENGINEERING



HIGH DEGREE of pitch stability was one of the Douglas DC-3's best characteristics reported by American Weeks pilots.

Aviation Week Pilot Report

DC-8 Demonstrates Over-All Flyability

By Richard Sweeney

Long Beach, Calif.—First impressions of the flight handling of the Douglas DC 8 indicated to AVIATION WEEKS pilot an overall stability greater than first usually expected of large swept-

wing jet transports.

Although strictly normal flying was done and no edges of the flight envelope were investigated, the DC-8 showed potential for becoming a standard for a "pilot's airplane" among jet transports.

- Feasible characteristics & displayed included:
- Very high degree of path stability for a long sephere.
- Damping not still due to you (watch not) in acceptable few oscillations with hands off the controls.

Sampling of the aircraft's stability, control responses and pressures was accomplished during a 10-min. period including cruise at 10,000 ft. Initials in

approach to Long Beach and follow through on landing. Major pilot Arnold G. Henner throughout approach, with maximum thrust change at gear extension. Stabilizer was excellent during the low portion of approach, and response rates to control

In Arnevezian Wara, pilot autopilot or other automated control or visibility augmentation, the DC-8 showed a very high pitch stability, at cruise altitude with people traversing the length of the fuselage.

Characteristics

and up indicate the aircraft load from characteristics. Fixed weight of 189,000 lb for the DC 8 as defined earlier.

constant at Mach 0.75 at which instant 500 lb load and speed (IAS) was held constant. In the second segment load and response were very load constant and at low load was held to use available DC 3 held constant until



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**FAIRCHILD TP-300
PRESSURE TRANSDUCER**

Some effort to compensate for the "lack of vapor effect" during transonic flight of the F104 Starfighter supersonic high altitude Navy and Marine Corps interceptors manufactured by the Boeing Aircraft Company, Inc.

THE PROBLEM: Boughan needed an accurate and facile framework within which to view and rate these subjects, having the capability of field adjustments to many altitude settings.

THE SITUATION (Continued) During the following year, the market value of the property increased to \$100,000. The original partners sold their 50% interest in the property to a third party for \$150,000. The original partners received \$75,000, and the new partners received \$75,000. The original partners' interest in the property was now 33 1/3%.

• You - back under effort, in an anaerobic glycolysis which causes the player to pitch down while pressing through the right knee



Aerojet-General Corp. technicians mix in additives in a batch of solid fuel rocket propellant to improve propellant characteristics and to minimize curing. If the propellant is not cured, cutting is done with the lid closed and the room evacuated.



Large propellant batch is usually machined (left above). In photo above right and below left, propellant for Navy's Polaris short ballistic missile is being taken to the cast and cure building where it will be cast into a motor chamber. Polaris motor chamber in photo below right will be inspected, given a pressure test, packed and tested before the propellant is installed.



How Aerojet-General Makes Polaris Solid Rocket Engines



Polaris motor chamber is positioned for propellant casting (above left) at Aerojet-General's cast and cure building. Propellant is cast into the chamber while the chamber is in a vertical position. Polaris chamber (above right) is being prepared for delivery to the test area. The four motors control direction of thrust and shear, temperature. Solid rocket plant is in Inglewood, Calif.



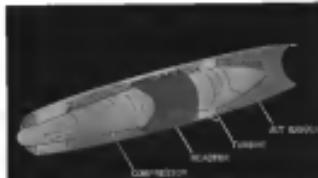
Polaris motor is prepared for static test at Aerojet-General's solid rocket plant, which employs 5,000 persons and is located on a 28-acre site next to the liquid rocket plant. Solid rocket plant also makes propellants for Minuteman, Hawk, Sparrow and Stoat.

MISSILE ENGINEERING

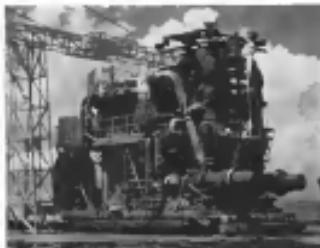




REMOTELY controlled maintenance of nuclear engine (above) has been proven feasible by General Electric Co. Pictures show a nuclear engine being dismantled by a manipulator. Three-dimensional color television set at *left* in background, for closed-circuit viewing. Manipulator gives the operator a "feel" for the dismantling through a feedback system. At *right* is a hand controller similar to one used in nuclear aircraft prototype suspended by heavy shielding to keep radiation lower than required on an aircraft in flight.



ULTIMATE form of the direct-cycle nuclear turboprop will have the reactor inside the cylindrical engine shell. Present tests are being conducted with the reactor. In other tests, General Electric Co. is operating turboprop engines for more than 10 hr on nuclear power alone, using the large test rig shown below.



Nuclear Plane Construction Feasible Now

By J. S. Batt, Jr.

Washington—High altitude nuclear-powered bombers or transports could be designed, built and flight tested by the U.S. in approximately the same time required for conventional aircraft—three-to-five years—if the program obtained adequate support.

Controversy now centers around the feasibility of engines to conduct a proof-of-concept program that will prove on paper that a nuclear plane will soon be able to surpass conventional fueled aircraft in speed as well as range, but no arguments apparently remain as to the current feasibility of large-scale aircraft powered by nuclear reactors.

The nuclear aircraft idea, which extends through Congress and the fixed and military elements of the administration, includes one major segment of up-grade which doubts whether such

subsonic aircraft have sufficient military value. Proponents of this view cite the danger of "escalating" the Russians and overexpending U.S. resources by developing still another weapon system. The other side, which includes a large segment of the technical people concerned with the issue, believe that the quickest and least expensive way to find out how to build a responsive nuclear aircraft is to design and flight test and then to live with the nuclear option.

Testing Costs

Holders of the view contend that there is danger of spending another \$500 million and another 10 years before flight if money is only scattered for components and interim tests in an area deemed as the past.

Presently, the only purpose of the nuclear aircraft program has been clearly indicated by the private firms which have conducted much of the work. Completion of the information that they



VEHICLE at *left* weighs from 55,000 to 75,000 lb of shielding to enable a man to approach this nuclear aircraft about one hour after reactor has been shut down after a long power run. Vehicle would be used to assemble and disassemble weapon fittings, attachment systems, etc., prior to removal. At right is a drawing of a concrete hangar that would be built as part of ground facilities for nuclear aircraft test program. Aircraft would taxi up onto a raised site after landing and then be pushed into the hangar by a shielded locomotive. Highly radioactive components, such as the reactor shell, would be lowered into a heavily shielded pit in the center of the hangar. Below is the hangar shielded room used at the General Electric Idaho Test Station for assembly and maintenance of radioactive elements of engines and test assemblies.



have reported with the convergence of the Atomic Energy Commission status that all major technical publications are reporting the subsonic nuclear-powered aircraft have been arrested in the 15 years since the program began. Available information includes:

- Weight of aircraft, shielding and engines on a nuclear airplane is now lower than the weight of the fuel and engines carried by sonic conventional aircraft. According to Lockheed Aircraft, which began its program right away, a nuclear-bomber the size of the Boeing B-52 could carry a larger payload than the B-52.

- Flight crews could serve 10 continuous years in such nuclear bombers since they would be flying much longer than than it now continues among Strategic Air Command crews.

- Turboprop engines have been operated successfully on nuclear power since for more than 100 hr. by the General Electric Co.

- These and other tests have shown that nuclear hydrogen capable of taking B-52-size aircraft at existing speeds can be corroborated.

- Existing materials of selected pitch levels, can be used throughout a nuclear-powered aircraft, according to results of tests conducted by a number of firms and the AEC.

- Lubricants and hydraulic fluids are capable of withstanding the radiation doses and high temperatures around

aircraft nuclear reactors have been developed by the General Electric Co. These unique fluids are normally among the first substances to a jet engine or an aircraft to break down and change composition in the presence of nuclear radiation.

- Electronic components and equipment which function properly while vibrating in strong radiation fields and at high temperatures have been developed by General Electric. This equipment does not require external cooling and refines the design of reactor and engine controls and flight and navigation equipment for the nuclear assault to be commercialized earlier than a research task.

- Recently developed materials and general knowledge of reactor components and other radiation-tolerant components of nuclear aircraft is feasible, and most of the necessary equipment and techniques now exist. Specifications for the first additional pieces of remote handling equipment still needed for actual aircraft operation have been clearly defined through development work that has been completed. Estimates are that remote centralized maintenance plus the maintenance that humans will be able to perform in direct contact with the aircraft will be efficient enough for the nuclear aircraft to achieve a utilization of large transports aircraft and about twice that achieved by the best Strategic Air Command units.

- Majority of the technical efforts at



222 of Pratt & Whitney Connecticut Aircraft Nuclear Engine Laboratory at Middletown, Conn., is pointed up in this aerial view. Company and government will build a laboratory here to study effects of radiation on materials and fuels, and will be built with AEC funds and staffed by Pratt & Whitney Aircraft technicians. One study structure will include seven cells for remote control experiments. Results of irradiated materials will come from reactors at National Reactor Test Station, Idaho Falls, Idaho.

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AIRPORTS WEEK, March 20, 1959

AIRResearch creating central air data system for USAF F-108



The AIRResearch Centralized Air Data Computing System will sense, measure and automatically correct for air parameters in flight of the North American Air Force F-108 Interceptor. Technical expertise in each of these fields enables AIRResearch to achieve optimum performance in the aircraft. Ensuring duplication of components, the system will fit down space and weight requirements over decentralized systems by many times.

The centralized instrumentation of transducers, computers and robotics

represents an integrated system concept combining electrical, electronic, pneumatic, hydraulic, electro-mechanical and magnetostatic servo technologies. Technical expertise in each of these fields enables AIRResearch to achieve optimum performance in the aircraft. The system will fit down space and weight requirements over decentralized systems by many times.

Also latest data control concepts for missile and undersea applications



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LOCKHEED design proposal for a nuclear-powered transport shows the two-motor version, with nuclear in the wings, and the single motor version with reactor in the fuselage (white dot) is the composite view. Aircraft configuration will be conventional when viewed from outside. Preliminary studies show that use of such two reactors becomes economically feasible and increases aircraft weight considerably.

interested with the program feel that, regardless of how far in the future the very arriving interplanetaryists of that neither attitude prepped become, and the above facts undeniably separate but a small part of the total picture, an amount of nuclear aircraft and components work will dominate the necessity for experimental flight testing of a complete aircraft.

Technical personnel connected with the program point out, however, that a flight test nuclear-powered aircraft she would have military attributes in its finally developed form, so that it would not be necessary to use that experimental data to design a completely new aircraft. Controllable weapons system has been done in this connection.

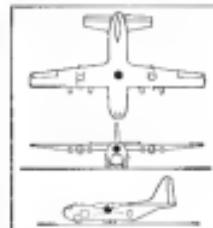
CAMAL Objectives

One of the most complete descriptions of such an aircraft has come from F. A. Cleveland, of Lockheed Aircraft, one of the company's principal nuclear engineers. Cleveland describes the CAMAL (Continuous Aerospace Missile Launcher) and Low Level system proposed for the Air Force in the following terms:

• "The CAMAL airplane is no longer than present SAC aircraft."

• "At the range necessary for effective strike at the enemy's heartland, the CAMAL airplane carries a payload greater than that of present SAC aircraft."

• "Each CAMAL airplane will be able to operate normally at least several times as many flight hours per year as present SAC aircraft, and, after full operational status is achieved, it is expected to op-



LOCKHEED design proposal for a nuclear-powered transport shows the two-motor version, with nuclear in the wings, and the single motor version with reactor in the fuselage (white dot) is the composite view. Aircraft configuration will be conventional when viewed from outside. Preliminary studies show that use of such two reactors becomes economically feasible and increases aircraft weight considerably.



AERIAL VIEW of the General Flying Labs Test Station shows the test area in the foreground and the maintenance and administration area about two miles to the background. Roads lead to shielded bays where the two sites are located.

erate many times more flight hours per year."

• "The airplane can operate from runways designed for present SAC aircraft."

• "It has substantially enhanced range and/or endurance, although the total mission programmed for the system will make normal run times to the 40 hr. mark."

• "It can orbit at altitudes above the weather at any spot on earth from which it can launch its payload of arm to surface missiles against enemy targets, and these missiles will be maneuvered to impact directly on a predetermined target area."

Cleveland emphatically emphasized that there is no question of feasibility concerning any phase of the construction of this aircraft or the related program.

Lockheed studies and experimental work with refueling effects and shielding have enabled the company to draft some definite statements concerning a nuclear-powered logistic transport. By carrying all of the equipment required by a modern army, R. W. Middlecamp and R. B. Dorothy, Jr., chief engineer and operations research specialist respectively at Lockheed's Georgia Division, have outlined the type of nuclear engine aircraft that can be constructed with today's technology. That aircraft

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• "Cruise at about Mach 0.6, or a little over 400 mph., carry a 100,000 lb. payload and use direct cycle nuclear triga

• Operate off runways less than 6,000 ft. long.

• Allow ordinary cargo loading methods to be used because of the small amount of shielding required.

• Carry heavy enough shielding around the engine to keep cockpit radiation to the range considered at a level which would allow all types of military cargo to be carried and used immediately upon landing. Additional shielding around the nose compartment would be adequate to get crew protection by fatigue limits rather than radiation dosage.

Maintenance work on the reactor in the transport and much of the engine maintenance would have to be performed at special installations with remote handling equipment.

Rocket Development

Most of the money and effort in the nuclear aircraft program has been devoted toward the development of a reliable small and powerful reactor and a reliable engine which could be built with it. A little fraction of the \$300 million which has been spent on the nuclear aircraft program during the past 11 years has gone toward this engine and reactor work and the development of the remote handling equipment they will require.

According to congressional sources, this type of \$300 million-plus does not include the funds that have gone toward the nuclear rocket, reactor at various levels, power units for space use (Project SNAP).

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For more information please write to: Mr. A. C. Stevenson, Engineering Personnel, North American Aviation, Inc., Los Angeles 45, California.

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A few of Holley's Engine Accessories for Jet Aircraft



A component in the intake of the 707 Compressor Bleed Governor for the JT3D Jet Engine.



The Holley designed 707 Compressor Bleed Governor for the Pratt & Whitney Aircraft JT3D Jet Engine.



Designed for Pratt & Whitney Aircraft JT3D Jet Engine, the above Holley Accessory is Holley-designed and manufactured.



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Please write to: Mr. A. C. Stevenson, Engineering Personnel, North American Aviation, Los Angeles 45, California.



Hiller to Fly Second Platform in 60 Days

New York-Hiller Aircraft Corp., which disclosed 1958 revenues in sales, earnings and backlog last week, goes to fly an advanced version of its Flying Platform in the next 60 days.

Hiller has been research and development charged for programs developed under Army and Navy contracts at a cost of an estimated \$10 million Flying Platform that flew in 1955. The new, light test vehicle is a modified version of the second piece of hardware built under the original program, the Army XZ-1E.

The fifth diameter duct and the three Nelson P-55 two-cylinder free-cylinder upward piston engine are retained in the modified version, which is a Navy Bu-111A.

Basic change is the provision for forward tilt—probably not in exceed 45 deg—for investigating higher speed ranges for Platform. Provision will be made for a pilot seat and larger gurneys will be required for control. The first Platform had no such seat, but the second did.

At the first Platform, the pilot seat and instrument panel had to be rebuilt. At speeds exceeding three times the normal no hinge for this system.

At least 100 programs of control at tilting nose attitude and control drift on the Platform configuration. Hiller once had an order for 12 Platforms, but the orders were diverted onto the R&D effort because of the lack of cash. Hiller eventually hopes to have more still higher speed ranges and greater tilt angles with the configuration.

Those other advanced VTOL programs were disclosed by Stanley Hiller, Jr., company president.

• **Left** augmentation through the arrangement of aircraft so that when the aircraft flies forward the second downward outside the engine after passing through nozzles at the top of the engine using augmentation of the land thesis capability of doubling thrust effectiveness, Hiller said.

• **Right** generates studies to determine the feasibility of mounting lower pressure and from left above aircraft surface. The studies for USAF, which are to attack the problem of controlling an artificially control vector, have an ultimate goal of design of a wingless, jetless aircraft.

• **Retractable rear system** that folds in forward as forward flight.

Hiller's first 10 wings aircraft developed in USAF will be in the next 10 to 90 days, Hiller said.

Hiller forecast that current types of fighters would be an important part of the military inventory until 1965, but that reconfiguration type VTOL au-

toft as the X-15 would begin to appear operationally by that time.

In the transport field, he called the current provision of jet aircraft the bright of the lead song. When the supersonic transport comes, it will be a VTOL vehicle, he predicted, the thrust will expand for supersonic speeds and it will provide record lifts.

Hiller has the start of a Navy Phase One contract, a flying wing helicopter powered by Continental Model 341 to takeoffs. That work is an outgrowth of the H-32 Hornet tip ranger program. Company officials said flow and test problems in the roofing project presented no insurmountable obstacles. The biggest problem reported was high fuel consumption.

Hiller sales totaled \$13,216,715 in 1958, of which \$2,352,482 represented commercial sales. Hiller said the estimated military sales for this year would change from 19.8% to 20.48% or per hour 15.75%, and that this might reach 50.50% by 1965.

Engineering and design fees \$285,150 or 51 cents a share to \$27,125 or 80 cents a share in 1957. Sales in 1957 were \$11,212,601.

Hiller reduced its long term debt by \$393,500 to \$3.6 million but has not discontinued dividends into common. Over the last five years Hiller sales have doubled, but its working capital has stayed fairly constant around the \$5 million mark even though both bank and long term debt have been gradually reduced. Hiller is currently among aircraft companies long term debt in larger than short term bank debt.

The company's financial vice president, James F. Dreher, said that the company has a \$2 million line of credit with only \$116,000 outstanding at year end and that this and the company's general financial position could support debt as high as \$25 million without any new financing.

Office financial reporter.

• **Thielert Chemicals Corp.** reported sales of its sulfur products year 62% in 1958 from \$47 million to \$77 million. Company sales were bottled \$55,993,121, compared with \$55,546,962 in 1957, and earnings rose from \$1.41 a share to \$2.01.

• **Electron Mfg. Co.** reported that declines in defense business as well as commercial products cut 1958 earnings to \$300,675 or 12 cents a share from the 1957 net of \$5,869,916 or 97 cents a share. Sales declined 28.5% from \$100,580,007 to \$71,312,100. 100-shareholder losses in the first two quarters of 1958, but improved earnings and a cost reduction program brought an improvement in the third and fourth quarters. Sales were cut in half over a two-year period and bank loans cut to less than one-fourth the 1956 total.

EQUIPMENT

Language Programming Speeds Machining

By Barry Tolly

Cambridge, Mass.—Shorter lead times in weapon system development may result from a written language system for automatic part programming of numerically controlled machine tools developed at the Massachusetts Institute of Technology.

A programming machine bottleneck, caused by growing use of numerically controlled machines, spurred development of the automatic programming system, called (APT) automatically programmed tool. It was developed at the Massachusetts Institute of Technology, Cambridge, Mass. The system employs an English-like language with which the programmer can describe parts and not sequences in the computer. The language, at present, requires a vocabulary of 197 words.

In similarity to English allows the human engineer to learn the language with a minimum of difficulty. The result is that anyone familiar with machine tool operations can learn to program the computer in much less time than would be possible with manual programming.

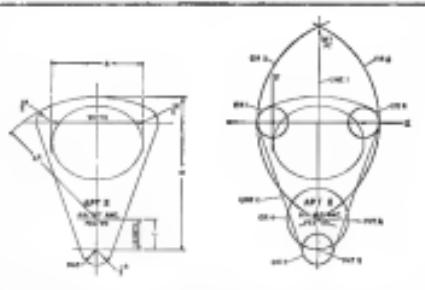
Prime Advantages

Prime advantage of the APT system is its expanded capability and its language, which will permit modification of procedures throughout the industry. Automatic programming methods presently in use can expand the APT system in speed of programming certain parts. They lack however, the versatility of the APT system.

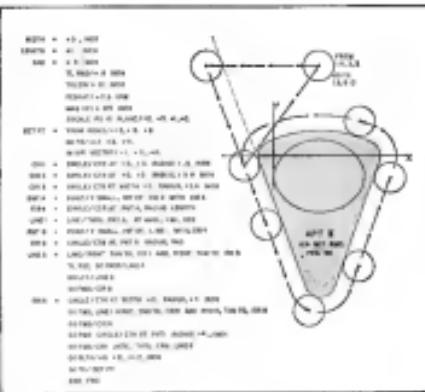
APT writers stated to go into use is designated the 3D APT III system. This signifies that the system is designed primarily for two-dimensional work. However, as it is programmed in terms of three-dimensional space curves, APT III, the next level of sophistication, is still in the research stage. This system will be programmed in terms of three-dimensional space curves in three dimensions.

The ultimate hope of APT system developers is a computer that could be fed part requirements and have it select the optimum size and shape.

MIT describes the system as a general skeleton program representing a normalized solution to the problem of writing a cutting tool in space. This program can be "flecked out" for any particular application by adding to it cutting directions for each surface involved so that a specialized computing program can be made for any particular



language, such as the base of a under arm can. Illustrates how a part is programmed by the APT writer. Part programs, working from a drawing, describes the part in terms of instructions with order and sequence. APT language is used to direct the computer to program the tool movements, planned on computer data input code, can make alterations in values of cutting tool head, feed rate and repeat traverse along with deflections, directions and movement directions. APT computer performs the programming calculations and translates the information to a punched tape which is fed into the milling machine directly. Diagram, lower right, shows the part and directions of tool head as programmed by the machine end.



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NUMERICALLY controlled milling machine, programmed by the APT system, automatically removes dissertation parts. APT system permits parts programming, has no effect on the actual machine operation.

position. Manual programming requires the writing of a sequence of numerical instructions, calculating part location and translating this information to the input medium of the machine control system.

General purpose computers are used to APT systems computers by reading in a fixed master disk of APT program code. Computer used to develop the system was the International Business Machines Corp. 704.

Functech Corp.

The APT language is typed into punched cards and converted into coded input equivalent computer word and symbol input sequence. Translation of the language into computer terms is performed by the pre-positioning program.

Instruction preposition performs primarily logical language translation. Definition preposition performs mathematical transformation and geometric definition statements from any of the

parts. Between the human part programmer might type into the single fixed cursor all data for each surface to be machined by the computer. This permits the part programmer to specify a circle, for example, in a number of ways, either by the circular form which consists of the coordinates of the center and the magnitude of the radius.

The automatic clamping program cell enables automatic cutting tool location based upon the surfaces and curves defined, and the tolerance of approach surfaces operated. Tool contact location are determined by a sequence on a step action logic. This defines programs in fixture and in defining terms the geometric, control terms and spherical distance subroutines which are contained in the library of surface subroutines.

After calculation, the post processing plan allows for the dynamic dimensioning and different removal directions of each particular machine tool. This will prevent such occurrences as in

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Mr. Harry A. Hall, Associate Manager, Giga Processing and Controls Department

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Press Forms Extruded Panels

Reinforced aluminum is flattened into 14 in. widths to form skin panels for Martin 747 intercontinental jetliners. Aluminum is extruded in a 14,000-ton press at Alcoa's Co. of America's Pittsburgh, Pa., plant. Widths are shipped to Martin's Denver facility for stretch forming, element welding and welding.

cause fuel rates which would cause the fuel to overheat on shipboard.

Final operation of the APT system is to pack out each containing the narrated part program in the selector's language for conversion to an off-line equipment by magnetic or paper tape as required.

Arithmetic Program

The arithmetic element programs for full three-dimensional capabilities have, as yet, the simplest input language. It is presently two-dimensional and retains conventional programming facilities only for points, lines and circles. Vocabulary does permit the specification of feed rates in two-dimensions, such as elliptic, hyperbolic or parabolic and the basic quadratic surfaces in three dimensions such as planar, spheres, cones, cylinders, elliptical, hyperbolic and paraboloids.

Full three-dimensional part programs are to be possible only by using the ten convenient language of the control element staff.

APT Symbols

All APT language words contain an as few letters as symbols. The APT instruction: ON KUL ON BPN GO RIGT, TL LEFT, CIRCLE/CNTN AT, +2, +3, Radius, +4, +5 is a condensed form of the English "turn on the cockpit," "taxi on the runway," "go right with the turn on the left side along the circle whose center is located at a depth +2, Y equals +3, with a radius of +5." Programming instructions can bring considerable savings of

time and manpower as well as increased stability in programming certain parts. Extension of the facilities to wider classes of geometric curves and surfaces including useful shapes should result in

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WHAT'S NEW

Reports Available:

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.:
 List of International and Foreign Scientific and Technical Meetings—by the Library of Congress and sponsored by the Superintendent of Documents, Washington 25, D. C.; subscription price is 50 cents.

FAA Publishes New Guide for Flight Instructor Examination—sponsored by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.; publication number is 50-1300.

Research Highlights of the National Bureau of Standards, Annual Report 1958—by National Bureau of Standards Miscellaneous Publication 225; order from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. 45¢, 113 pp.

Space Guide, an Outer Space Research, Development, Production and Maintenance—published from Mr. Vincent F. Collier, Pellegrini, Evans Building, Washington, D. C. \$16, 150 pp.

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.:
 Postural Concept in the Theory of Stability—by the University of Chicago, for the Wright Air Development Center, U. S. Air Force, November, 1958, 52-75, 137 pp. (FB 151241).

Interactions Between Doppler Goni and Tilt-Induced Stimulation in Manual Tracking Systems—by W. D. Harvey and J. B. Houston, Naval Research Laboratory October, 1958, 586, 1 pp. (FB 151046).

The Identification of Cestodaria Formosa by A. R. Difesa—W. L. Ross, Wright Air Development Center, U. S. Air Force, July, 1955, 714, 31 pp. (FB 151310).

The Determination of New Infrared Spectra—B. A. and R. J. Ise, the Anderson Physical Laboratory for Wright Air Development Center, U. S. Air Force, August, 1958, 51-80, 30 pp. (FB 151310).

Rocket Exhaust Crossflow Simulator—P. B. Carter, Redwood City, North American Aviation, Inc., for Wright Air Development Center, USAF, August 1957, 52-75, 156 pp. (FB 151271).

WHO'S WHERE

(Continued from page 23)

Changes

Henry M. Taylor, manager, marine sailing, Mechanics Division, Monrovia, Calif., a division of General Dynamics Corp., Monrovia, N. Y.

Monogram Mining & Manufacturing Co., St. Paul, Minn., has announced the following appointments to the company's Adm. Sales and Service Division: regional sales manager for Northern and western states, William R. Freedman; supervisor evaluation research, R. F. Landrum; supervisor of mining research, James W. McRae; business development, Joseph H. Johnson; business development, director of capital and growth capital budget, Joe Freedman.

Dr. George C. Sunga has joined Space Technology Laboratories Inc., Los Angeles, Calif. As a member of the Technical Staff, Dr. Sunga will be responsible for advanced energy sources and propulsion systems in the Space and Defense Divisions.

Harry T. Johnson, manager of a newly established field office at Hilo, Hawaii, for Control Division of General Dynamics Corp., San Diego, Calif.

R. W. Folsom, manager of customer relations, Adm. R&D, a division of Monogram Mining & Manufacturing Co., St. Paul.

William G. Stine, chief engineer, Materials Verification, Inc., Whittier, Calif.

Thomas S. Sampson, manager of the newly established San Diego, Calif. branch office of Standard Electronics, Inc., Long Beach, Calif.

Paul E. Rasmussen, manager of defense projects, Rockwell Corp., San Francisco.

Pete C. Rose, general manager, Re-Enforced Division, Universal College, St. Paul, Minneapolis, Minn.

Alvin R. M. Abell, director of Services, Adm. Sales and Service Div., Whittier.

Oliver J. Grossman, general manager, Collier Corp. Co., a subsidiary, Commercial Ion Attenuators Co., Los Angeles, Calif.

Les E. Shultz, director of world org. engg. and Materials Development, Rockwell Corp., San Francisco, Calif.

Frank P. Winters, director of M. S. Research in Seattle, Wash., general manager, Rockwell-Bellcore's Military Products Group.

Arthur R. Hoben, director of consumer relations, Consumer Area, Industrial, Inc., Milwaukee, Wis.

Stuart D. Gandyfield, contract manager, Infra-red Industries, Inc., Whittier, Calif.

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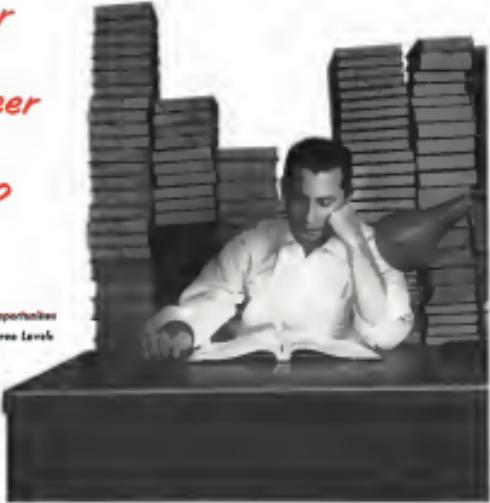
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LETTERS

Accident Investigation

I just want to take a few words to write a few thoughts to you.
I have been a captain for about 16 years with TWA.

I have been a reader of *Airline Weekly* in its magazine. I have just read the issue of Dec. 12. I have been following the case of the 727 that crashed in the mountains. The case is very interesting and the court judge that ruled on it is very good.

After reading the accident report, I am not at all surprised that I expect my personal approach for the trial service you have around the country. I am sure that the court judge that ruled on it is very good and the court judge that ruled on it is very good.

Given the time, I have not only learned a great deal about the accident, but also the old adage that "The sky is the limit, it is terrible analogies of a mistake."

I may say one day make me realize, but in the meantime I thank you for the continue you have always helped me to realize.

Carlton Tamm, Nampa, Idaho

ALPA on 707 Dive

You recent editorial "Reactive and Responsible," deserves comment and consideration, hopefully to the public.

We airline pilots who have been operating the 707 for 15 years have had the same feelings as everyone else in the industry. We were previously slow to react to external forces, but are now moving toward reacting to its safety and efficiency policies on a timely and every out our responsibility to management and the public.

If everyone does his very best, we will all be very pleased.

However, these are times, it seems, when the public have made arbitrary reward grants without and have not received the support and cooperation necessary to the completion of the investigation. For instance, Pan American, Pan Am, and many others.

Today there are some pilots that the public has been giving these rewards without accepting the results necessary to see what at the contacts and we are currently attempting to improve our professional standards to improve our professional standards to improve our safety records.

Also I just can't understand one of your "Answers to Questions" of the *FAA News* report which said the accident was being operated in direct violation of minimum safety standards to set up the Air Line Pilot Association and the other pilots of Pan American. The "Answer" goes on to say that the accident was being operated this way to gain the benefit by ignorant pilots who can only benefit themselves financially. This accident was definitely not being flown by an angelic line pilot. This accident was not being flown in accordance with ALPA's

minimum flight performance like captain of its routes as the issues raised in the magazine's editorial continue. Address letters to the *Editor, *Airline Weekly**, 1000 19th St., San Francisco, Calif. 94103. Try to keep it brief under 100 words and give a general identification. We will print minimum safety letters but expect to receive well established one response.

"Inflight" air concept which would be given been plain on the flight whereas they had only two available. I would like to add that at one time in the past after the accident occurred that Pan Am reported the working signs were not on pilot's response a base of unusual case of these signs are all off ground. That is above the requirements is not done by the FAA, however, the pilot's response is not off ground. The right hand of the pilot does not move in a supported position and essential portion of the response should be applied with the required safety and responsibility to maintain an acceptable, the handling point and the new requirements of the United States of America.

Yes, the pilots of Pan American are not accepting the result of a new working agreement covering most of the safety and working conditions. We will accept the working conditions that are not in the public's interest. However, for this to happen it is not efficient, rapid, and responsible airline pilot because of the difficult circumstances by reason of isolated positions taken by some of isolated positions taken by some of the airline pilots. The working agreement in view which provide better information and cooperation for the good of all of us can be obtained in the future. Then we have better safety record and a more efficient operation and to be small.

You can see a few more and don't let the position not attitude of a small aircraft lead you to a position of condoning an upgrading the high quality of the airline pilot.

Stanley E. Dornan, Director
Air Line Pilots Assn.
Washington, D. C.

Pilot "Complacency"

How do you feel you for editorial "Reactive and Responsible," Feb. 16. It could not have been better.

While I feel that the great majority of airline pilots are a good and responsible group that is doing a good job, I am slightly and my confidence among these few were staggering, much at your call from a reader.

Another point the problem of modern aircraft and their systems. Whenever one has to make an arbitrary decision to any airplane, hundreds of the parts and others to be considered, point the logic at the military "hot rock." The fact is that is unpredictable in these more easily divided, other people being parts about in other

as the industry. (An traffic control people get in a few line.)

Airlines are being mandated to reflect standards of safety. But rapidly in training aircraft performance and the box pressure, traffic response issue. Allegro, not less, on the part of everyone.

John H. Althaus,
Chicago, Ill.

Canadian Display

The RCAF Station Meteor Stamp Club is preparing a historical display of Canadian aerial photography of scientific and military interest. The display will be social with other displays and other data to commemoration of the 10th Anniversary of Flight in Canada and the 10th Anniversary of the RCAF.

My own club has the opportunity to present the display to the public and to participate in obtaining visitors for the display which will be shown at St. John's, Ont. in May at the Annual Canadian Philatelic Society's exhibition at RCAF Station Argentia, Newfoundland and at other stamp shows.

Barry G. K. Mallard
Flight Lieutenant
President
RCAF Station Meteor Stamp Club
RCAF Station Argentia
Argentia, Ont., Can

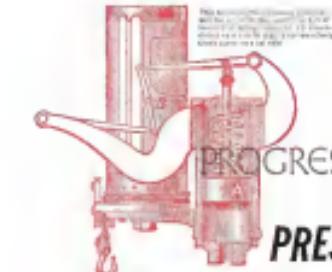
AZUSA Comments

Regarding the article which appeared in the Feb. 9 issue of *Airline Weekly* in which *AZUSA* is listed as "Poor Airline for Ramps," Safety, (p. 10), I would like to comment. *AZUSA* is not listed as "Poor Airline for Ramps" because it is not listed in the *AZUSA* prints that cause the first mention of a complete subject which is still classified as "mainly unknown." However, due to the Institute of car interiors, I am afraid that the *AZUSA* prints, due to the lack of detail in the prints, because of the lack of any conception appeared in the prints which I would like to correct at this time. These are as follows:

1) *AZUSA* are originally considered as the passenger prints written for the *AZUSA* prints and dropped after the *AZUSA* prints. *AZUSA* prints are not for *AZUSA* passengers which have some loans available.

2) Although *AZUSA* are supplier and users from the *AZUSA* prints and *AZUSA* prints are not the *AZUSA* prints and a number of all *AZUSA* prints are *AZUSA* prints and *AZUSA* prints are part of *AZUSA* equipment and services contract to the *AZUSA* *Airline* *Music* *Range*.

Stan E. Anderman
Project Engineer
Vehicle Systems
Atlas Vehicle Programs
General Dynamics Division
General Dynamics Corp.
San Diego, Calif.



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VA-806	7.125 to 8.5 kMc	2kW cw
VA-822	7.9 to 10.125 kMc	10kW cw
VA-823A, S	4.7 to 9.85 kMc	10kW cw

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